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THE METABOLIC RESPONSE OF YOUNG WOMEN TO A STANDARDIZED DIET

Home Economics Research Report No. 16

Agricultural Research Service

UNITED STATES DEPARTMENT OF AGRICULTURE

THE METABOLIC RESPONSE OF YOUNG WOMEN TO A STANDARDIZED DIET

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Growth Through Agricultural Progress

Home Economics Research Report No. 16

Human Nutrition Research Division

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At the University of Alabama, School of Home Economics: **Leader:** Frieda L. Meyer. **Supporting staff:** John Bentley, Joanna Buck, James Carter, Lora Clark, Anne Henderson, Dorothy Penick, Rose Tilley, and Kathleen Stitt.

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At the University of Nebraska, Department of Home Economics and the Agricultural Experiment Station: **Leaders:** Hellen Linkswiler and Hazel Fox. **Supporting staff:** Eda Ree Eckblade, Peggy Crooke Fry, Donna Geschwender, Evan Hansen, and Virginia Tompkins.

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The Metabolic Response of Young Women to a Standardized Diet

By Ruth M. Leverton, Jane M. Leichsenring, Hellen Linkswiler, Hazel Fox, and Frieda L. Meyer

SUMMARY

To aid in the understanding of nutritional requirements and in the interpretation of nutritional data, the metabolic response of normal young women to a standardized diet was determined. Thirty college women served as subjects for a period of 20 days, the first 5 days of which they ate their self-chosen diets, followed by 15 days on a standardized diet. The study was then extended to determine the response of 15 of the subjects to altered levels of magnesium intake in the standardized diet and the response of 8 of the subjects to altered levels of pantothenic acid intake. Analyses of the intake and the excretion of nitrogen, calcium, phosphorus, magnesium, thiamine, riboflavin, pantothenic acid, and fat of each subject provided the bases for interpreting metabolic response. The summary of results is given for the 10-day period which followed a 5-day adjustment period in the standardized diet, except for magnesium and pantothenic acid when the summary includes the results on the different levels of intake.

Nitrogen

On an intake of approximately 11 gm. of nitrogen daily, none of the 30 subjects were in negative balance. The retentions of the 30 subjects ranged from 0.36 to 2.61 gm. of nitrogen daily and averaged 1.60 gm. In this 10-day and in subsequent periods, however, one-third to over one-half of the subjects retained less than 1 gm. of nitrogen daily. The results suggest that the level of intake closely approximated the requirement for maintaining nitrogen equilibrium in this group of subjects.

Calcium

On a mean daily calcium intake that approximated 757 mg. the balances of the 30 subjects ranged from -138 to 130 mg., and averaged zero. Fourteen of these subjects were in negative calcium balance, which indicates that this level of in-

take was not sufficient to maintain equilibrium in the entire group of subjects.

Phosphorus

The phosphorus intake was approximately 950 mg. daily and the balances of the 30 subjects ranged from -162 to 215 mg. daily. Ten subjects were in negative phosphorus balance.

Magnesium

The magnesium balances of the subjects on different levels of intake increased significantly as the intake increased. A mean daily intake of 183 mg. of magnesium was inadequate for maintaining equilibrium in any of the subjects who were studied on this level; an intake of 320 mg. maintained equilibrium or promoted storage in all of the subjects studied on this level. On the intermediate intakes of 274 to 282 mg., 37 percent of the subjects were in slight negative balance. The results suggest, therefore, that a daily intake of at least 280 mg. of magnesium, and perhaps more, would be needed to insure equilibrium in all of the women studied.

Thiamine

On a daily intake of 800 μ g. of thiamine only 4 of the 30 subjects had urinary excretions large enough to meet the criteria used as indicative of adequate thiamine nutrition. Nine subjects met these criteria when they were on self-chosen diets. The estimated thiamine content of these self-chosen diets ranged from 1,100 to 1,760 μ g. daily. The urinary excretion of thiamine by the subjects on the controlled intake ranged from 26 to 213 μ g. daily, which represented from 3.8 to 27.0 percent of the intake.

Riboflavin

The standardized diet supplied approximately 900 μ g. of riboflavin daily and the urinary excre-

tion of the subjects ranged from 56 to 242 μg . daily, or from 5.9 to 27.8 percent of the intake. These excretion values did not consistently meet any of the criteria suggested as indicative of adequate riboflavin nutrition of the body.

Pantothenic Acid

The intake and excretion of pantothenic acid were determined for eight of the subjects. Daily intakes of 2.8, 7.8, and 12.8 mg. resulted in mean urinary excretions of 3.1, 4.5, and 5.6 mg., re-

spectively, and the correlation coefficient of intake and urinary excretion was 0.80.

Fat

The standardized diet supplied 90 gm. of fat daily and the fecal excretion of the subjects ranged from 1.38 to 3.48 gm. daily. The mean daily fecal excretion of fat was relatively stable for each of the subjects throughout the different periods of the study and seldom varied more than 0.5 gm.

INTRODUCTION

Information on the requirements of human beings for the essential nutrients is needed for appraising the adequacy of available food supplies and estimating the food production necessary for satisfying nutritional needs. Interpretation of existing data on human requirements is difficult, because of the differences in the diets that have been used by workers in different laboratories for the study of the various nutrients. Such differences also complicate the task of establishing the range in response of normal individuals to a given diet. Results from a reasonably large number of subjects studied under uniform experimental conditions, especially of dietary intake, and the simultaneous measurement of the body's response to several nutrients would increase greatly the information and understanding of human requirements and the interrelationships and utilization of nutrients.

To aid in accomplishing such an objective, research workers in the Human Nutrition Research Division of the Agricultural Research Service have developed a standardized diet for metabolic studies (21).¹ The diet is constructed so that it is possible to maintain reasonably constant intakes of the essential nutrients from uniform sources over extended periods of time. In addition, it is possible to vary the level of one nutrient while keeping the level of all the other nutrients practically unchanged under various experimental conditions. The acceptability and practicality of the

diet were established by testing it with six young women for a period of 40 days.

With the standardized diet available as a research tool, a study was undertaken with the primary purpose of determining the range in metabolic response of a group of 30 young women to the diet and thus aid in the interpretation of nutritional data. The plan included a metabolism study of the women for a period of 20 days, the first 5 days during which they ate their self-chosen diets, followed by 15 days when they were on the standardized diet.

Another purpose was accomplished when it was possible to extend the study of 23 of the 30 women beyond the initial 20 days and determine the response of 15 of them to altered levels of magnesium intake, and the response of 8 of them to altered levels of pantothenic acid intake. These extensions contributed to the overall study of normal ranges in metabolic response.

The investigation was carried out in four nutrition research laboratories in the Home Economics Departments of the Universities of Alabama, Minnesota, and Nebraska, and the Oklahoma State University. The work at each location was supported in part by a U.S. Department of Agriculture contract sponsored by the Human Nutrition Research Division.

¹ Italic numbers in parentheses refer to Literature Cited, page 29.

PROCEDURE

Subjects

The number of women who served as subjects at each location, and the duration and dates of the study were as follows:

Alabama	6 women	20 days	November 1 to 20, 1955
Minnesota	7 women	35 days	January 10 to February 13, 1957
Nebraska	8 women	40 days	February 10 to March 21, 1956
Oklahoma	9 women (1 subject did not com- plete the last 20 days)	40 days	February 6 to March 16, 1956

The code number, age, and certain physical measurements of each subject are given in table 1. Age ranged from 18 to 24 years, weight from 47.3 to 73.2 kilograms, height from 158.1 to 177.8 centimeters, surface area from 1.46 to 1.89 square meters, and basal metabolic rate from 1,159 to 1,534 Calories per 24 hours. According to the recent table of weight for height prepared by Hathaway (12), 24 of the 30 subjects were within 10 percent of the expected median weight, and 6 between 11 and 15 percent. Of these 6 subjects, the weights of 4 were above, and 2 below the expected median weight. Basal metabolic rates for 21 of the subjects were within 10 percent of the standard proposed by Boothby, Berkson, and Dunn (5), 5 subjects were 11 to 15 percent below,

TABLE 1.—*Description of subjects*

State and subject code number	Age ¹	Weight		Height	Surface area ³	Basal metabolic rate	
		Initial	Devia-tion ²			Total per 24 hours	Devia-tion ⁴
Years	Kilograms	Percent	Centi-meters	Square-meters	Calories	Percent	
Alabama:							
101	23	58.1	-4	163.8	1.63	1,159	-18
102	21	54.5	-2	159.4	1.55	1,282	-5
103	21	52.2	-6	162.6	1.55	1,238	-8
104	21	64.4	-1	175.3	1.78	1,447	-6
105	21	60.1	-2	168.3	1.69	1,320	-10
106	20	64.6	-14	164.5	1.70	1,306	-12
Average		59.0		165.6	1.65	1,292	
Minnesota:							
201	18	61.8	-9	165.1	1.68	1,358	-8
202	20	55.0	-2	163.8	1.59	1,392	-1
203	19	48.1	-8	158.1	1.46	1,267	-2
204	19	54.5	-4	165.1	1.59	1,375	-2
205	21	53.4	-14	173.4	1.64	1,409	-1
206	20	61.6	0	172.7	1.73	1,534	-2
207	19	47.3	-11	159.4	1.46	1,411	-10
Average		54.5		165.4	1.59	1,392	
Nebraska:							
301	19	47.3	-10	158.7	1.46	1,314	-2
302	21	49.8	-6	158.7	1.49	1,193	-8
303	24	73.2	-14	175.9	1.89	1,511	-8
304	18	57.3	0	165.7	1.63	1,388	-3
305	19	56.0	-4	167.0	1.62	1,418	-1
306	23	68.9	-9	174.6	1.83	1,394	-12
307	19	63.6	-6	170.8	1.74	1,378	-10
308	20	62.3	-6	168.3	1.71	1,213	-18
Average		59.8		167.5	1.67	1,351	
Oklahoma:							
401	19	63.9	-1	176.5	1.79	1,430	-9
402	22	60.7	-7	177.8	1.76	1,328	-13
403	20	64.9	-4	174.0	1.78	1,483	-4
404	21	63.4	-11	165.9	1.70	1,210	-18
405	21	56.2	-3	161.3	1.58	1,260	-8
406	20	71.4	-15	173.5	1.85	1,373	-14
407	22	63.7	-7	169.4	1.73	1,260	-16
408	21	57.8	-5	171.4	1.68	1,395	-4
409	20	60.5	-3	173.5	1.73	1,327	-12
Average		62.5		171.5	1.73	1,341	
Average for all subjects	20	59.2		167.8	1.67	1,346	

¹ To nearest birthday.² From tables for ages 20-24 by Hathaway (12).³ Calculated from the formula of DuBois and DuBois (8): Area (sq. cm.) = Wt. kg. ^{0.425} × Ht. cm. ^{0.725} × 71.84.⁴ From standards proposed by Boothby, Berkson, and Dunn (5).

and 4 subjects were 16 to 18 percent below this suggested standard.

The women were judged to be in good health on the basis of thorough medical examinations.

The subjects at the University of Alabama were housed together. On the other three campuses the subjects lived in their usual residences and had headquarters for dining and daytime activities in the nutrition research laboratories.

Standardized Diet

The standardized diet developed and tested in the nutrition research laboratories of the Agricultural Research Service is a combination of ordinary foods which provides palatable meals but low levels of most of the nutrients. The diet is then supplemented with synthetic and purified products, so that the total intake provides adequate levels of

essential nutrients. These levels were not planned to include the margins of safety provided by the recommended allowances of the Food and Nutrition Board of the National Academy of Sciences, National Research Council (25), because high nutrient intakes may mask individual differences in metabolic response or alter interrelationships among nutrients.

The term "reference" is used to designate these adequate levels and to distinguish them from the modified or altered levels of certain nutrients which are used later in the study.

TABLE 2.—*Estimated nutritive value of the standardized diet*

Nutrient	Core	Complement I	Complement II	Reference
Food energy—calories	550	1,450	0	2,000
Nitrogen—grams	3.2	7.8	0	11
Fat—do	10	80	0	90
Carbohydrate—do	100	150	0	250
Calcium—milligrams	150	50	500	700
Phosphorus—do	300	300	400	1,000
Magnesium—do	65	17	148	230
Iron—do	4	2	4	10
Copper—do	0.6	0.2	0	0.8
Iodine—do	0.090	0.015	0	0.105
Manganese—do	1	1	0	2
Potassium—do	900	200	1,000	2,100
Sodium—do	300	Trace	2,100	2,400
Zinc—do	3	1	0	4
Vitamin A value— International units	1,000	1,500	1,500	4,000
Vitamin D—do		400	400	
Ascorbic acid—milligrams	10		50	60
Thiamine—do	0.15	0.15	0.5	0.8
Riboflavin—do	0.3	0.2	0.5	1.0
Niacin—do	5	2	0	7
Folic acid—micrograms	25	25	50	100
Pantothenic acid—milligrams	2	1	1	4
Pyridoxine—do	0.3	Trace	0.5	0.8
Choline—do	120	80	100	300
Cobalamin (B ₁₂)—micrograms	1		4	5

The estimated nutritive value of the standardized diet with the reference levels of nutrients is shown in table 2. The diet consists of three components: (1) A "core" made up of natural and refined foods which forms the nucleus for the meals; (2) complement I composed of refined foods, primarily to bring food energy and protein to desired levels; and (3) complement II composed of mineral salts and purified vitamins to provide these nutrients at reference levels. It was in complement II that the modifications were made when other than reference levels of magnesium or pantothenic acid were used in the present study.

The kinds and amounts of foods in the core and complement I and their distribution into meal patterns are shown in table 3. Meal patterns were used in the following order for successive 5-day periods: Pattern 1, 2, 1, 2, and 3. Adjustments were made in the amounts of sugar and jelly used for different subjects in order to meet the calorie requirement of each subject and maintain her at a constant weight. Distilled water and instant coffee and instant tea, made with distilled water, and sodium chloride were allowed ad lib. A record was kept of the tea and coffee intake.

TABLE 3.—*Meal patterns and amounts of foods per person per day in the standardized diet*

Items	Pattern 1	Pattern 2	Pattern 3
CORE:			
Breakfast:			
Applesauce, canned	Grams	Grams	Grams
Farina, unenriched (dry weight)	100	100	100
Rice Krispies, ¹ unenriched	20	—	—
Cheerios, ¹ unenriched	—	15	—
Evaporated milk	25	25	25
Lunch:			
Rice, precooked, unenriched (dry weight)	25	—	25
Spaghetti, unenriched (dry weight)	—	25	—
Tomato puree	30	30	30
Lettuce	20	20	20
Pears and juice, canned	100	—	100
Dinner:			
Beef (raw weight) ²	45	45	—
Haddock, frozen fillet (raw weight) ²	—	—	50
Potato, precooked and dried (dry weight)	25	25	25
Green beans, frozen (cooked weight)	100	—	100
Celery, frozen (thawed weight)	60	—	—
Peaches and juice, canned	100	—	—
COMPLEMENT I:			
Rolls, weighed as dough (casein, gluten and cake flour, sugar, fat)	250	250	250
Cookies, weighed as dough (cake flour, sugar, fat)	75	25	75
Dough for cobbler (peach) (cake flour, sugar, fat)	—	65	—
Butterfat	45	45	45
Sugar ³	5	5	5
Jelly, grape and apple ³	30	30	30
Gelatin, granulated	2	2	2

¹ Mention of specific products does not imply recommendation by the U.S. Department of Agriculture over others of a similar nature not mentioned.

² Amounts adjusted to supply approximately 1.6 gm. nitrogen.

³ Amounts adjusted to take care of individual calorie requirements.

TABLE 4.—*Calculated fat and fatty acid content of the standardized diet*

Source of fat	Total fat	Selected fatty acids			
		Total saturated	Total unsaturated	Oleic	Linoleic
From foods:					
Evaporated milk	Grams 2.0	Grams 1.10	Grams 0.78	Grams 0.66	Grams 0.06
Beef	1.4	.67	.66	.62	.03
Flour (cake, gluten)	2.0	.28	1.52	.62	.84
Cereals:					
Farina, spaghetti	.2	.03	.15	.06	.08
Cheerios ¹	.1	.02	.07	.03	.04
Subtotal	5.7	2.10	3.18	1.99	1.05
From added fat:					
Hydrogenated fat ²	23	10.33	12.67	9.78	2.60
Butterfat ³	60	33.00	23.40	19.80	1.80
Total	88.7	45.43	39.25	31.57	5.45

¹ See footnote 1, table 3.² Used in preparation of rolls, tomato puree, meat-potato.³ 15 gm. used in preparation of cookies and cobbler, 45 gm. as table fat.

The preparation of foods and the recipes used were the same as have been described in Section III of Meyer and others (21), except for a few changes.²

Cereals, cake flour, gluten flour, casein, instant potato, spaghetti, rice, and the vitamins and gelatin capsules were each purchased in one lot and distributed to the four laboratories. This was true also for the hydrogenated fat, which was a commercial product made from meat and vegetable fats. Specified brands of canned and frozen foods were secured locally. The total quantity of these needed for the duration of the study in each location was purchased at one time. The celery was purchased locally and blanched and frozen for use throughout the study. Lettuce, of course, had to be purchased fresh as needed.

Butterfat was prepared at each laboratory and was used in the cookies and cobbler dough and as table fat. Hydrogenated fat was used in the preparation of the tomato puree and rolls and in

² The changes in food preparation from that described by Meyer and others (21) were as follows:

The inner white stalks of green celery were used at three locations, because bleached celery was not available.

Tomato juice was used in the tomato puree, because the canned tomatoes were likely to contain a calcium salt.

Beef was packaged and frozen in individual portions rather than in the total amount needed for a meal.

The amount of butterfat was increased from 35 to 45 gm. per person per day.

The amount of magnesium gluconate added to the rolls was increased to supply approximately 148 mg. instead of 100 mg. of magnesium.

cooking the meat or fish. The calculated fatty acid content (11) of the diet is shown in table 4.

The calculated amino acid content (28) is shown in table 5 and compared with requirements of the amino acids as summarized in the report of the Food and Nutrition Board (26). The diet contained 19 mg. of niacin equivalence (12 from tryptophan and 7 from niacin), using the suggested figures of 60 mg. of tryptophan equivalent to 1 mg. of niacin (25).

TABLE 5.—*Calculated amino acid content of the standardized diet and suggested requirements and proportionality pattern*

Amino acids	In standardized diet	Food and Nutrition Board	
		Minimal requirements for women	Proportionality pattern (tryptophan=1)
	Grams	Milligrams	
Isoleucine	3.034	450	2.9
Leucine	4.813	620	3.8
Lysine	2.618	500	3.2
Methionine	1.204	350	2.2
Cystine	1.009	200	1.3
Total sulfur A.A.	2.213	550	3.5
Phenylalanine	3.176	220	1.4
Tyrosine	1.985	900	5.7
Total aromatic A.A.	5.161	1,120	7.1
Threonine	2.035	305	1.9
Tryptophan	.722	157	1.0
Valine	3.206	650	4.1

The amounts of vitamins and minerals added in purified form in Complement II are shown in table 2. One-third of the day's supply of the B vitamins was given in solution at each meal. Thiamine, riboflavin, pyridoxine, and choline were dissolved in 0.02 N acetic acid, and calcium pantothenate, folic acid, and cobalamin were dissolved in water. Ascorbic acid was given in a gelatin capsule with the breakfast, as was another gelatin capsule containing the vitamin A and D concentrate. The calcium diphosphate was given in a capsule with every meal. The iron, magnesium, and potassium salts were added to the water used in the preparation of the roll dough.

Changes in the magnesium or in the pantothenic acid content of the standardized diet were made by altering the amount of the nutrient in Complement II.

Sequence of Periods and Levels of Intake

The length of the study at each location was divided into consecutive periods of 5 days each and designated A, B, C, D, etc., through Period H. During the first 5 days of the study, Period A, the subjects were on their customary self-chosen diets. They recorded their food consumption in estimated household measures and these records were used for calculating the nutritive value of the self-chosen diets.

Beginning with the sixth day, the first day of Period B, and continuing until the end of the study, all of the subjects were fed the standardized diet. Period B, the first 5 days that the subjects were on the standardized diet, was considered a transition or adjustment period, and the intake and excretion values are not included in the calculations of subsequent means or in the regression equations. Following Period B, the subjects were kept on the same level of intake for at least two periods or 10 days.

The levels of certain nutrients in the standardized diet for the different periods were as follows:

PERIODS B, C, AND D.—All of the subjects were on the standardized diet with the intake of nutrients designated as "reference levels." These levels of the nutrients for which the diet was analyzed at each location are shown in table 6.

TABLE 6.—*Analyzed values for standardized diet used at four locations (Per person per day)*

Nutrient	Ala-bama	Minne-sota	Nebras-ka	Oklahoma
Nitrogen—grams	10.64	11.40	11.06	11.16
Fat—do—	86.40	89.70	92.30	87.90
Calcium—milligrams	703	742	728	830
Phosphorus—do—	938	976	942	936
Magnesium—do—	252	320	274	247
Thiamine—micrograms	741	832	790	786
Riboflavin—do—	970	949	872	891

PERIODS E AND F.—The magnesium intake of the 7 Minnesota subjects was reduced from 320 to 238 mg. daily. The magnesium intake of Oklahoma subjects 401, 403, 405, 407, and 409 was decreased from 247 to 180 mg. daily; while the intake of subjects 402, 404, and 406 was increased to 280 mg. (Subject 408 did not continue with the study after Period D.)

The pantothenic acid intake of Nebraska subjects 301, 302, 303, and 304 was increased to 7.8 mg.; while the intake of subjects 305, 306, 307, and 308 was increased to 12.8 mg.

PERIODS G AND H.—The Minnesota subjects were continued through Period G on the same levels as in Periods E and F. However, the Oklahoma subjects were "switched," so that each subject received the alternate level of magnesium which was being studied there. The odd-numbered subjects received 280 mg. daily and the even-numbered subjects, 180 mg.

The Nebraska subjects were also switched, so that subjects 301 to 304 received 12.8 mg. of pantothenic acid and subjects 305 to 308 received 7.8 mg.

Collection and Preservation of Materials

The materials collected and preserved for analysis throughout this metabolic study included food, urine, and feces. Aliquots of food were collected for the group at each location beginning with the standardized diet in Period B. Collections of urine and feces, however, began with the first day of Period A.

FOOD.—A composite was made of the core foods used in each 5-day period. The foods were combined in a Waring Blender and made into a slurry with 0.1 N HCl. Portions from each lot or recipe of rolls, of cookies, and of cobbler were treated similarly. For the pantothenic acid determinations made in the Nebraska study, duplicate composites were made without the HCl as a preservative. All slurries were stored at -20°C .

URINE.—Glacial acetic acid to give a final concentration of 2 percent was added to the urine collections. Completeness of 24-hour collections of urine was checked by determination of creatinine, then the collections for each subject were made into a 5-day composite. An aliquot of this composite was stored at -20°C . and used later for thiamine and riboflavin determinations. A second aliquot, preserved with 10-percent HCl, was stored at room temperature and used for nitrogen and mineral analyses. In the Nebraska study a portion of each urine collection was preserved with toluene for the determination of pantothenic acid.

FECES.—A capsule containing 300 mg. of carmine was given to each subject before breakfast at the beginning of each 5-day period to mark the feces. Each fecal collection was either frozen as soon as possible or acidified with 10 percent by weight of acetic acid and refrigerated. The 5-day composite was blended with water and aliquots

TABLE 7.—Summary of constituents determined, materials analyzed, and methods used

Constituent and method	Material analyzed			Reference
	Food	Urine	Feces	
Creatinine, Colorimetric		x		Clark and Thompson (7).
Nitrogen, Volumetric	x	x	x	Assoc. Off. Agr. Chem.—Kjeldahl-Gunning-Arnold (2).
Fat, Gravimetric	x	x	x	Markely and Hann (16).
Calcium, ¹ Volumetric	x	x	x	A.O.A.C. Acid hydrolysis (2). Modified by treating with yeast to ferment out the sugar.
Phosphorus, ¹ Colorimetric	x	x	x	Ingols and Murray (14).
Magnesium, ¹ Colorimetric	x	x	x	Fiske and Subbarow (9).
Thiamine, Fluorometric	x	x	x	Orange and Rhein (27).
Riboflavin, Fluorometric	x	x	x	Assoc. Vitamin Chem., Inc.—Methods of Vitamin Assay (3). Mickelsen, Condiff, and Keys (22).
Pantothenic acid, Microbiological	x	x	x	Assoc. Vitamin Chem., Inc.—Methods of Vitamin Assay (3). Najjar (24), and Slater and Morrell (30), Meyer <i>et al.</i> —Modification (21).
				Zook, MacArthur, and Toepfer (32): Free and total pantothenic acid. Free pantothenic acid.

¹ Material was dry ashed below 550° C., A.O.A.C. (2).

were taken for the determination of fat. Another aliquot was acidified with 10-percent HCl and used for nitrogen and mineral analyses. All aliquots were stored at -20° C.

Analytical Methods

The methods which were used for analysis of the food, urine, and feces are summarized in table 7. The details are described by Meyer and others (21). A Farrand or Coleman photofluorometer was used for the fluorometric readings and a DU Beckman spectrophotometer, Coleman spectrophotometer, or Evelyn colorimeter for all colorimetric readings.

Calculation of Nutritive Value of Self-Chosen Diets

Tables of Watt and Merrill (31) were the chief source of figures of food composition used in calculating the nutritive value of the 5-day self-chosen diets which had been recorded by the subjects in estimated household measures of servings. When necessary, figures were used from the tables of Bowes and Church (6). The magnesium content of the diets was calculated from figures given by McCance and Widdowson (18, 19), supplemented by those of Sherman (29). The pantothenic acid content was calculated from the figures given by Zook and others (32).

RESULTS

The results of the metabolic study will be presented first for the constituents determined in the intake, urine, and feces—nitrogen, calcium, phosphorus, and magnesium; and then for the constituents determined in the intake and the urinary excretion only—thiamine, riboflavin, and pantothenic acid; and finally for the constituent determined in the intake and the fecal excretion only—fat. Urinary creatinine values will accompany the nitrogen figures. The text and tables will deal chiefly with mean values for all of the subjects studied, or for the subjects at each location. In some instances the mean value for the excretion or retention of the subjects at one

location was found to be significantly different from the mean for the subjects at another location. Such differences among normal, healthy young women, however, were not considered to have significance for the objectives of this study, inasmuch as its primary purpose was to determine the range in the metabolic response of normal individuals to a standardized diet.

Results for the two 5-day periods C and D, when the intakes remained unchanged, have been averaged and a mean value given for the 10 days designated as "Periods CD." The data for Periods E and F, and for Periods G and H have been averaged similarly and the values designated

TABLE 8.—NITROGEN: Mean and standard deviation for intake, excretion, and balance for subjects in each State and for all subjects during different periods

State, number of subjects, and period	Intake		Urine		Feces		Balance		Subjects in negative balance Number
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	
Alabama—6 subjects:									
A	Grams 12.87	Grams 1.00	Grams 8.51	Grams 1.40	Grams 1.24	Grams 0.11	Grams 3.12	Grams 1.69	0
B	10.65	.05	8.84	1.28	.92	.19	.89	1.16	1
CD	10.64	.03	8.64	.60	.96	.15	1.03	.49	0
Minnesota—7 subjects:									
A	11.39	2.01	8.36	1.49	.90	.33	2.13	.76	0
B	10.86	.10	9.11	.29	1.09	.14	.66	.34	0
CD	12.08	.09	9.15	.29	.79	.17	2.14	.28	0
EF	11.04	.11	9.34	.33	.81	.23	.89	.36	0
G	11.03	.10	9.29	.33	.89	.20	.84	.33	0
Nebraska—8 subjects:									
A	13.11	2.96	10.32	1.36	.97	.28	1.82	2.58	1
B	11.00	.06	9.88	.74	.95	.38	.17	.87	3
CD	11.06	.06	9.49	.37	.81	.20	.76	.34	0
EF	11.00	.06	9.50	.33	.77	.28	.73	.27	0
GH	11.04	.07	9.32	.22	.87	.16	.86	.21	0
Oklahoma—9 subjects:									
A	14.42	2.63	9.48	.83	1.41	.33	3.53	2.26	1
B	11.01	.00	7.11	.40	.81	.33	3.09	.48	3
CD	11.16	.00	7.89	.25	.95	.16	2.31	.25	0
EF—8 subjects	10.41	.16	8.38	.45	1.02	.13	1.01	.42	0
GH—8 subjects	10.51	.04	8.33	.24	1.03	.11	1.19	.30	0
All States:									
A—30 subjects	13.05	2.51	9.25	1.44	1.14	.35	2.66	2.05	1
B—30 subjects	10.90	.15	8.66	1.30	.94	.29	1.31	1.41	4
CD—30 subjects	11.24	.51	8.76	.74	.88	.18	1.60	.77	0
EF—23 subjects	10.81	.32	9.06	.62	.87	.24	.88	.36	0
GH—16 subjects	10.78	.28	8.82	.56	.95	.15	1.02	.30	0

as results for "Periods EF" and "Periods GH." Because of the desirability of including in the results the averages for the same number of days at each location, figures for Period G in the Minnesota study were not averaged with those for Periods EF or with the results for Periods GH from other locations.

The results obtained for each subject for each 5-day period throughout the study are given in appendix table 26.

Nitrogen

The mean and standard deviation of the intake, excretion and balance of nitrogen for the subjects at each location, and for all subjects, during different periods are summarized in table 8. Also shown are the ranges in the nitrogen balances and the number of subjects in negative balance during each period.

The coefficients of variation for the intake, excretion and balance for all of the subjects studied in different periods are shown in table 9.

TABLE 9.—NITROGEN: *Mean, standard deviation, and coefficient of variation for retention*

Number of subjects	Period	Mean daily retention	Standard deviation	Coefficient of variation
<i>Grams</i>				
30	CD	1.60	0.77	48
23 ¹	CD	1.72	.77	45
23	EF	.88	.36	41
16 ²	CD	1.53	.85	55
16	EF	.87	.37	43
16	GH	1.02	.30	30

¹ Minnesota, Nebraska, and Oklahoma subjects; subject 408 omitted.

² Nebraska and Oklahoma subjects; subject 408 omitted.

The nitrogen intakes recorded for Period A are the calculated protein intakes divided by the factor 6.25. The self-chosen food intake of the 30 subjects supplied a mean of 13.05 ± 2.51 gm. of nitrogen daily and the estimated mean retention for the group was 2.66 ± 2.05 gm. The daily intakes ranged from 6.12 to 18.90 gm. and the retentions on these two extremes of intake represented also the range in the retentions of the 30 subjects, namely—3.52 and 8.14 gm., respectively. (Appendix table 26.)

When the subjects went onto the standardized diet, the controlled nitrogen intakes of 10.65 to 11.01 gm. were lower for 24 of the subjects than had been provided by their self-chosen diets. The 4 subjects who went into negative balance in Period B were among these 24. The coefficient of variation in the retentions increased from 77 percent in Period A to 108 percent in Period B.

After Period B there were no negative nitrogen balances among the 30 women. During Periods CD the mean daily retention ranged from 0.36

gm. of nitrogen for subject 303 to 2.61 for subject 407, and the mean for the 30 subjects was 1.60 ± 0.77 gm. on a mean intake of 11.24 ± 0.51 gm. The coefficient of variation in the retentions of the subjects dropped from 108 percent in Period B to 48 percent for Periods CD.

The mean nitrogen retention decreased for 15 of the 23 subjects who were continued on the standardized diet after Periods CD, but remained quite constant for the other 8 subjects.

The nitrogen balances of the individual subjects for the different periods on the standardized diet are shown graphically in figure 1. The noticeable reduction in the variability among the subjects as the length of time increased on the controlled intake is indicated in table 9. Considering all of the subjects studied, the coefficient of variation for the nitrogen retention was 48 percent for the 30 subjects in Periods CD, 41 percent for the 23 subjects in Periods EF, and 30 percent for the 16 subjects continued through Periods GH.

Also given in table 9 are the mean balance, standard deviation, and coefficient of variation for only the 23 subjects in Periods CD who were studied through Periods EF, and for the still smaller group of 16 subjects who were studied through Periods EF and GH. For the 16 subjects who were studied the longest time, 30 days on the standardized diet, the standard deviation of the mean balance decreased steadily from Periods CD to EF to GH. When these values were calculated for the group of 23 subjects who were studied in Periods EF as well as in CD, there was only a slight reduction in variability.

The results of measuring the nitrogen balance of these 30 subjects indicate that following an adjustment period of 5 days (Period B), a daily intake of 11.24 gm. of nitrogen for 10 days, Periods CD, was sufficient to permit daily retentions ranging from 0.36 to 2.61 gm. for the individual subjects. During the next 10 days, Periods EF, when the nitrogen intake was 10.81 gm. for 23 of these 30 subjects, the range in retention was reduced to 0.20 to 1.52 gm., with a mean of 0.88 gm. A third 10-day period, Periods GH, for 16 of the subjects resulted in the range in response being further reduced to 0.64 to 1.69 gm., with a mean retention of 1.02 gm. (table 8).

In each 10-day period one-third to over one-half of the subjects retained less than 1 gm. of nitrogen daily, 10 of the 30 subjects in Periods CD, 13 of the 23 subjects in Periods EF, and 8 of the 16 subjects in Periods GH. This would suggest that in planning diets for similar nutrition studies, a daily nitrogen intake of less than 11 gm. for healthy young women might result in some negative balances among the subjects.

Creatinine

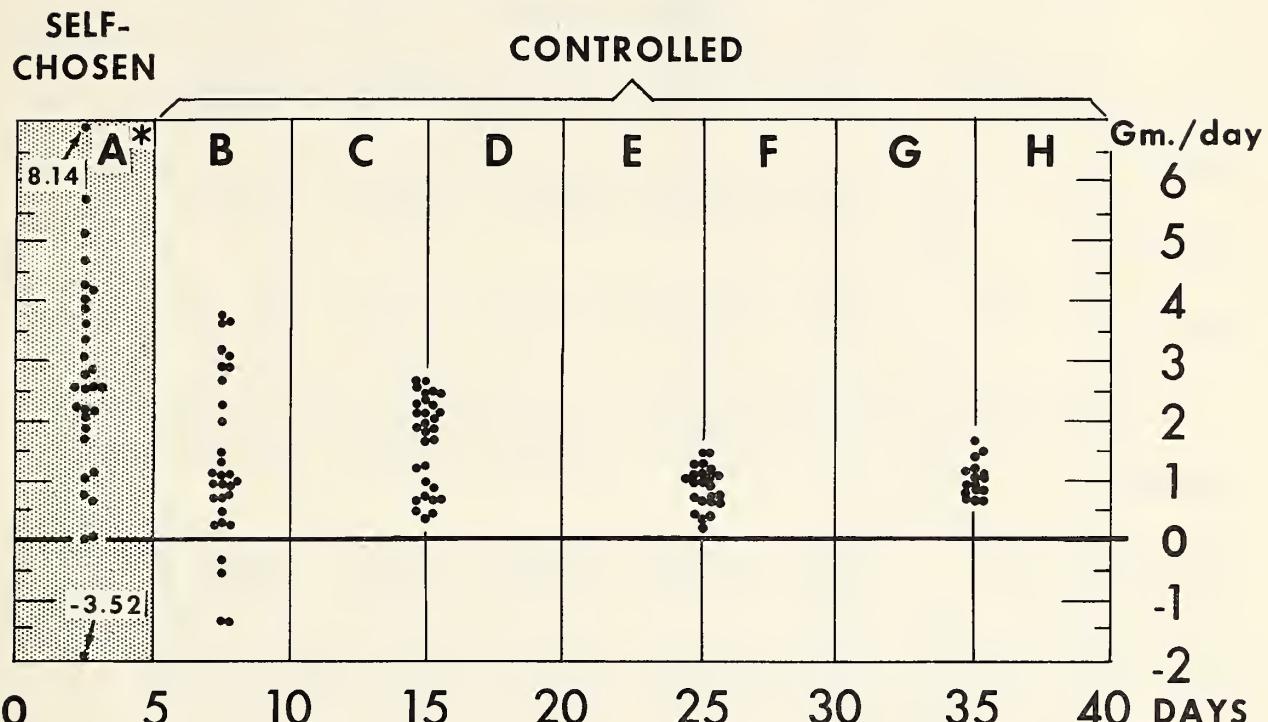
The mean creatinine values for the different periods are shown in table 10 expressed on the basis of the grams excreted per person per 24 hours, and as milligrams per kilogram of body

TABLE 10.—CREATININE: Mean, standard deviation, and coefficient of variation of total excretion and excretion per kilogram of body weight, and ratio of urinary nitrogen to total creatinine for different periods

Period	Subjects	Total excretion per 24 hours		Excretion per kilogram of total weight per 24 hours		Ratio of urinary nitrogen to creatinine	
		Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
A	Number	Grams	Grams	Milli-grams	Milli-grams	Percent	Percent
A	30	1.35	0.24	18	22.7	14	16
B	30	1.27	.19	15	21.5	10	11
CD	30	1.17	.10	9	19.9	1.7	2.2
EF	23	1.21	.10	8	20.6	2.0	.83
GH	16	1.21	.11	9	19.8	1.4	.74
						7	.74
						7.33	10
							10

NITROGEN BALANCE

Variability on Controlled Diet for 35 Days



*SELF-CHOSEN DIET, NITROGEN CONTENT CALCULATED.

EACH LETTER REPRESENTS A 5-DAY PERIOD.

FIGURE 1.

weight. The two sets of values exhibit similar patterns. The means and coefficients of variation decreased from Period A to Periods CD and then remained about the same from Periods EF to Periods GH.

The range in individual creatinine excretion values was greatest in Period A—from 0.92 to 1.79 gm. per 24 hours, and six subjects (all in Oklahoma) excreted more than 1.60 gm. daily. Subject 403, who had the highest excretion—1.79 gm. of creatinine—was not the largest subject but she had the highest calculated nitrogen intake for Period A—18.9 gm. Subject 401 with a creatinine excretion of 1.73 gm., the second highest among the subjects, however, had a daily nitrogen intake of only 10.9 gm. In general, the creatinine excretions decreased when the subjects were on the standardized diet. In Periods CD and subsequent periods, the range in daily values was from 0.93 to 1.41 gm. The subject who had the smallest total excretion of creatinine also had the smallest excretion per kilogram. The subject who had the largest total excretion had the largest excretion per kilogram.

Also given in table 10 is the ratio of the urinary nitrogen to the creatinine excretion for the

different periods. This ratio increased from Period A to Periods CD and then remained relatively constant. The higher coefficient of variation in Period B is a result of four subjects having been in negative nitrogen balance during that 5-day period.

Calcium

The mean and standard deviation of the daily intake, excretion, and balance of calcium for the subjects in each location, and for all subjects, during the successive periods are presented in table 11. Also shown are the ranges in the balances and the number of subjects in negative balance. The calcium balance of each subject for these periods is charted in figure 2.

The calculated calcium intakes of the 30 subjects during Period A ranged from 495 to 1,372 mg. daily, with a mean of 1,000 mg. daily. The mean estimated calcium retention was 48 mg., but 12 of the subjects were in negative balance.

The mean daily intake and balance of calcium during Period B on the standardized diet was 742 and —62 mg., respectively. This intake was a decrease from the self-chosen diets for 25 of the 30 subjects. Of these 25, 12 went from a state

TABLE 11.—CALCIUM: Mean and standard deviation for daily intake, excretion, and balance for subjects in each State and for all subjects during different periods

State, number of subjects, and period	Intake		Urine		Fees		Balance		Subjects in negative balance	Number
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation		
Alabama—6 subjects:										
A	958	230	194	74	768	174	165	—4	—186 to 259	3
B	703	1	145	58	529	37	51	—13 to 113	2	
CD	703	1	149	54	553	62	50	—60 to 72	3	
Minnesota—7 subjects:										
A	1,017	284	136	64	689	288	192	221	—75 to 605	1
B	722	—	123	48	781	249	—182	241	—662 to 28	6
CD	742	—	133	54	581	96	29	71	—58 to 130	3
EF	736	—	132	49	617	117	—13	122	—250 to 158	4
G	718	—	130	57	700	89	—112	68	—249 to —53	7
Nebraska—8 subjects:										
A	976	287	200	48	646	174	131	222	—228 to 395	2
B	718	—	170	48	604	210	—57	214	—389 to 218	4
CD	728	—	184	51	565	79	—21	84	—138 to 106	3
EF	726	—	183	49	519	104	24	71	—74 to 150	3
GH	730	1	177	47	633	101	—81	117	—326 to 38	6
Oklahoma—9 subjects:										
A	1,036	194	187	56	951	253	—102	314	—562 to 412	6
B	806	—	242	80	599	217	—34	158	—266 to 165	5
CD	830	3	185	57	650	99	—5	78	—126 to 120	5
EF	836	6	196	42	629	119	11	84	—106 to 134	3
GH	828	4	177	60	597	85	55	55	—2 to 96	1
All States:										
A—30 subjects	1,000	239	180	62	772	247	48	261	—562 to 605	12
B—30 subjects	742	43	175	75	629	212	—62	189	—662 to 218	17
CD—30 subjects	757	50	165	56	592	92	0	72	—138 to 130	14
EF—23 subjects	767	51	172	52	587	113	8	90	—250 to 158	10
GH—16 subjects	779	51	177	52	615	92	—13	113	—326 to 96	7

CALCIUM BALANCE

Variability on Controlled Diet for 35 Days

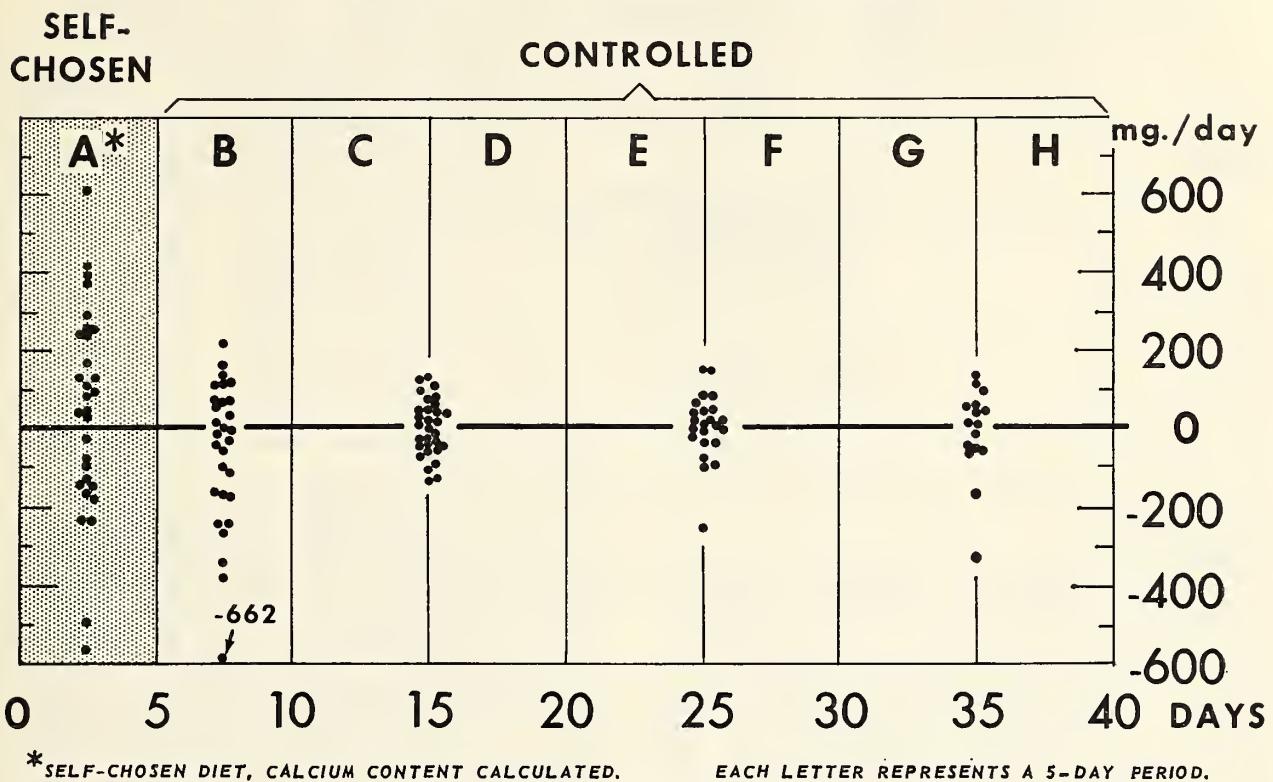


FIGURE 2.

of storing calcium in Period A into one of losing calcium in Period B. Of the 5 subjects who had increased calcium intakes in Period B, as compared with Period A, 3 subjects changed from a negative balance in Period A to a positive balance in Period B.

In Periods CD the mean daily calcium intake was 757 mg., and the balances ranged from -138 to 130 mg. daily, with a mean of zero and a standard deviation of 72 mg. Of the 30 subjects 14 were in negative calcium balance which ranged from -138 to -1 mg. daily. The slightly different calcium intakes at the four locations, ranging from 703 mg. in Alabama to 830 mg. in Oklahoma, did not appear to affect materially the mean balances of the subjects. Both the Alabama and the Oklahoma women had a mean balance of less than 1 percent of the intake and approximately one-half of the subjects at each of these locations were in negative balance. This was true also of the mean balance for the other 15 subjects.

The proportion of the ingested calcium that was excreted in the urine and in the feces was similar when food supplied all of the calcium in Period A and when calcium diphosphate supplied two-

thirds or more of the calcium in the standardized diet.

The coefficients of variation for the intake and excretion of calcium for the different periods are shown in table 12. There was little reduction in the variability among subjects in urinary or fecal calcium excretion in successive periods on the standardized diet. The wide range from negative to positive calcium balances which resulted in the

TABLE 12.—CALCIUM: *Coefficient of variation for intake and excretion*

Period	Sub- jects	Coefficient of variation		
		Intake	Urine	Feces
A-----	Number	Percent	Percent	Percent
A-----	30	24	34	32
B-----	30	6	43	34
CD-----	30	7	34	15
EF-----	23	7	30	19
GH-----	16	7	29	15

TABLE 13.—CALCIUM AND PHOSPHORUS: *Effect of magnesium intake on mean daily balances*

State and period(s)	Daily magnesium intake	Subjects	Daily balance			
			Calcium		Phosphorus	
			Mean	Standard deviation	Mean	Standard deviation
Oklahoma:						
CD	248	All 9 subjects	—5	78	168	148
EF	180	401, 403, 405, 407, 409	11	84	143	32
GH	280	402, 404, 406	55	55	126	27
EF-GH	180	401, 403, 405, 407, 409	25	100	144	35
EF-GH	280	All 8 subjects	41	33	125	22
Minnesota:						
CD	320	All 7 subjects	29	71	130	51
EF	232	All 7 subjects	—13	122	—8	96
G	232	All 7 subjects	—112	68	—40	54

large standard deviations of the mean balances makes coefficients of variation for the balances meaningless.

Following Periods CD, the daily magnesium intake was altered for the Oklahoma and Minnesota subjects. Because some of the Oklahoma subjects were receiving more magnesium than others in Periods EF and in Periods GH, figures are given in table 13 to show the mean calcium balances (and phosphorus balances) on the different magnesium intakes. Similar data are shown for the Minnesota subjects for Periods EF and Period G.

The mean calcium balance of the Oklahoma subjects was —5 mg. daily in Periods CD and improved slightly in subsequent periods irrespective of the magnesium level of the diets. When the magnesium intake was 180 mg., the mean daily calcium retention was 25 mg. and three subjects were in negative calcium balance. When the magnesium intake was increased to 280 mg., the mean calcium retention increased to 41 mg., and no subject could be considered in negative calcium balance (the —2 mg. recorded for one subject is less than 0.25 percent of the intake). The difference between the mean balances was not statistically significant. The smaller standard deviation of the mean when the magnesium intake was 280 mg. may have been due in part to 5 of these 8 subjects having been on the standardized diet for a longer time.

The lower magnesium intake of the Minnesota subjects in Periods EF and G was accompanied by a decrease in mean calcium balance from 29 mg. in Periods CD to —13 mg. in Periods EF, to —112 mg. in Period G. Only this latter change was statistically significant.

The Nebraska subjects were maintained on the same magnesium as well as calcium intakes through Periods EF and GH, and the mean

calcium balances for them varied from —21 mg. in Periods CD to 24 mg. in Periods EF, to —81 mg. in Periods GH. When the six 5-day periods are combined, the mean daily calcium balance over the 30 days was —26 mg. Five of the 8 subjects were in negative balance. (See table 11.)

It is apparent, therefore, that the changes in calcium and phosphorus balances which occurred when the magnesium intake was altered were not consistent. In several instances such changes were no greater than occurred during different periods when the magnesium intake was kept constant.

The range in the responses of these subjects to the daily calcium intakes of 703 to 836 mg. indicates that these amounts are not sufficient to maintain calcium equilibrium in a group of young women similar to the subjects in this study. The overall range of the daily calcium balances was 268 mg. (from —138 to 130 mg.) in Periods CD, 408 mg. (from —250 to 158 mg.) in Periods EF, and 422 mg. (from —326 to 96 mg.) in Periods GH. Two subjects were in much greater negative balance than the other subjects—subject 201 who had a daily calcium balance of —250 mg. in Periods EF and subject 306 who had a balance of —326 mg. in Periods GH. Disregarding these two subjects reduces the overall range in calcium response from 408 to 264 mg. (—106 to 158 mg.) for Periods EF, and from 422 to 268 mg. (—172 to 96 mg.) for Periods GH. The extent of these ranges is the same as for Periods CD, 268 mg. (table 11).

Phosphorus

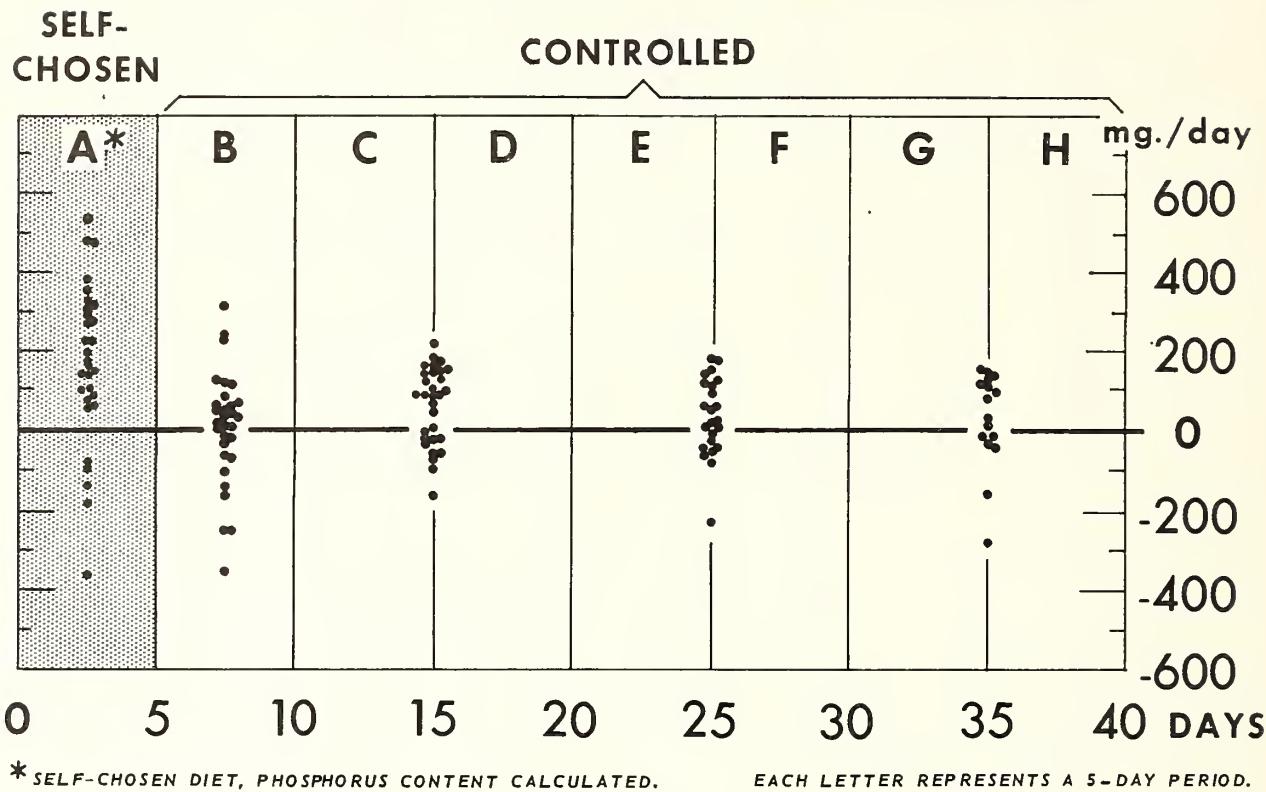
In table 14 are presented the figures for the mean daily phosphorus intake, excretion, and balance for the subjects in each location and for all subjects for successive periods, together with the ranges in balances and the number of subjects in negative balance. The coefficients of variation

TABLE 14.—PHOSPHORUS: Mean and standard deviation for daily intake, excretion, and balance for subjects in each State and for all subjects during different periods

State, number of subjects, and period	Intake		Urine		Feces		Balance		Subjects in negative balance
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	
Alabama—6 subjects:									
A	1,322	206	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Number 1
B	938	—	698	141	476	62	189	—184 to 329	1
CD	938	—	496	78	388	58	84	—105 to 123	1
			520	84	416	52	64	—95 to 90	3
Minnesota—7 subjects:									
A	1,308	319	684	143	429	153	195	77 to 388	0
B	991	—	573	32	493	124	75	—352 to 36	5
CD	1,039	—	549	53	359	22	50	80 to 215	0
EF	976	—	573	36	411	90	—8	—220 to 60	2
G	982	—	586	35	436	27	—40	—120 to 34	5
Nebraska—8 subjects:									
A	1,350	295	775	105	432	98	142	—359 to 481	2
B	959	—	615	81	421	130	77	—241 to 66	4
CD	942	—	560	74	419	104	—36	—162 to 98	7
EF	954	1	586	40	365	66	—4	—78 to 69	3
GH	945	1	534	65	468	141	—57	—271 to 32	6
Oklahoma—9 subjects:									
A	1,408	242	711	133	506	126	191	231	2
B	901	—	468	70	315	134	118	—14 to 311	1
CD	936	2	449	78	339	72	148	90 to 188	0
EF	925	11	445	45	337	67	143	96 to 188	0
GH	920	6	468	53	326	71	126	85 to 159	0
All States:									
A—30 subjects	1,352	259	719	128	462	115	171	203	5
B—30 subjects	945	34	537	89	400	131	8	142	11
CD—30 subjects	962	42	516	84	380	77	66	98	10
EF—23 subjects	951	22	533	76	369	77	49	95	5
GH—16 subjects	933	14	501	67	397	129	35	119	6

PHOSPHORUS BALANCE

Variability on Controlled Diet for 35 Days



* SELF-CHOSEN DIET, PHOSPHORUS CONTENT CALCULATED.

EACH LETTER REPRESENTS A 5-DAY PERIOD.

FIGURE 3.

for the intake and excretion of phosphorus are given in table 15. The phosphorus balance of each subject for these periods is shown in figure 3.

The calculated daily phosphorus intakes for Period A ranged from 763 to 1,844 mg. and averaged 1,352 mg. The mean estimated retention was 171 mg. daily. Only 5 subjects were in negative balance and 4 of them had intakes below 1,200 mg. and the fifth subject had an unusually high excretion.

TABLE 15.—PHOSPHORUS: *Coefficient of variation of intake and excretion*

Period	Subjects	Coefficient of variation		
		Intake	Urine	Feces
		Number	Percent	Percent
A-----	30	19	18	25
B-----	30	4	17	33
CD-----	30	4	16	20
EF-----	23	2	14	21
GH-----	16	1	13	33

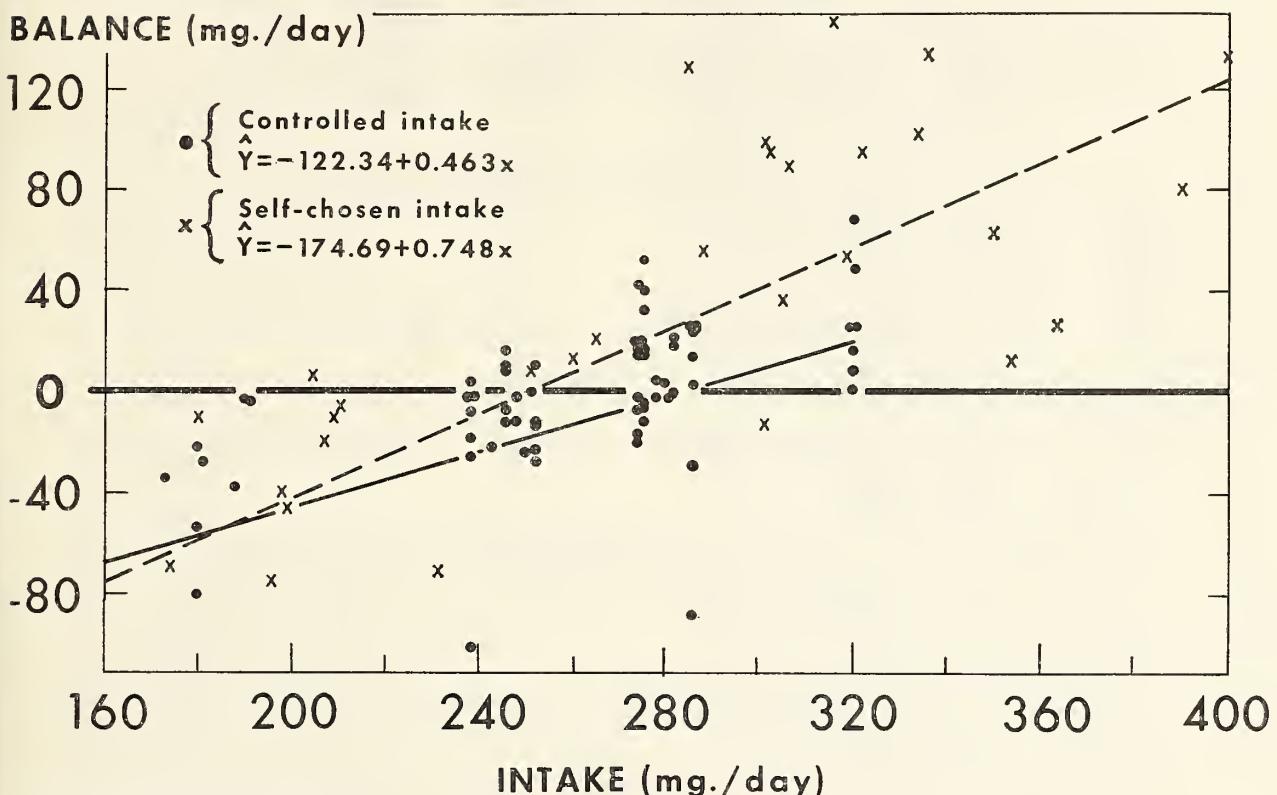
The standardized diet supplied approximately 30 percent less phosphorus than had been calculated for the self-chosen diets in Period A, 945 mg. as compared with 1,352 mg., but only 11 of the 30 subjects went into negative phosphorus balance in Period B. In Periods CD the mean daily retention for the 30 subjects was 66 mg. of phosphorus, with 10 subjects in negative balance. In Periods EF and GH the mean retention dropped to 49 mg. and 35 mg., respectively, and a smaller proportion of the subjects were in negative balance.

The standard deviations of the mean retentions were always much greater than the means and did not decrease progressively with successive periods on the standardized diet.

In general, a higher percentage of ingested phosphorus was excreted in the feces during the periods on the standardized diet when two-fifths or more of the phosphorus was supplied by calcium diphosphate, than in Period A when all of the phosphorus was supplied by food. The increases in fecal phosphorus were substantial for all of the subjects except those in Oklahoma. Their consistently higher retention of phosphorus while on the standardized diet may indicate that they were able to absorb

INTAKE AND BALANCE OF MAGNESIUM

Controlled and Self-Chosen Diets



Source: Leverton and others (15).

FIGURE 4.

phosphorus from the calcium diphosphate more efficiently than subjects at the other locations. None of the Oklahoma subjects were in negative balance after Period B; in general, they had a lower urinary excretion and a lower fecal excretion of this mineral than the other subjects. Also variability among the Oklahoma subjects, as indicated by the standard deviations of the mean retentions, was less than for the subjects at the other locations. This "location" difference in the phosphorus results was not evident in the nitrogen and calcium results.

The changes in magnesium intake for the Oklahoma subjects did not affect their phosphorus retentions (table 13). In the Minnesota subjects, however, there was a significant drop from a mean phosphorus retention of 130 mg. in Periods CD, when the magnesium intake was 320 mg. daily, to -8 mg. of phosphorus in Periods EF and to -40 mg. in Period G, when the magnesium intake was 232 mg. (table 13).

The range in the response of the subjects to the controlled phosphorus intake of approximately 950 mg. daily was similar to that for calcium. There were, however, somewhat fewer negative phosphorus than calcium balances. The results

suggest that 950 mg. of phosphorus daily is not sufficient to maintain equilibrium in a group of young women similar to the subjects in this study. The extent of the overall range in the phosphorus balances was 377 mg. (-162 to 215 mg.) for Periods CD, 408 mg. (-220 to 188 mg.) for Periods EF, and 430 mg. (-271 to 159 mg.) for Periods GH. As with calcium, subject 201 in Periods EF and subject 306 in Periods GH had a much larger negative balance than the other subjects. Omitting them from the calculation of the overall range reduces the extent of the range to 266 and 313 mg. for Periods EF and GH, respectively, as compared with the range of 377 mg. for Periods CD. (See table 14.)

Magnesium

The mean daily intake and balance of magnesium for the subjects in each State and for all subjects during different periods are shown in table 16, together with the ranges in balances and the number of subjects in negative balance. The magnesium balance of each subject on each level of intake on which she was studied is charted in figure 4 for both the controlled and the self-chosen

TABLE 16.—MAGNESIUM: *Mean and standard deviation for daily intake, excretion, and balance for subjects in each State and for all subjects during different periods*

State, number of subjects, and period	Intake		Urine		Feces		Balance	Range in balances	Subjects in negative balance
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation			
Alabama—6 subjects:									
A	Milligrams 244	Milligrams 46	Milligrams 95	Milligrams 19	Milligrams 130	Milligrams 11	Milligrams 39	-11 to 96	2
B	252	252	95	26	141	19	23	-8 to 47	2
CD	252	106	21	157	27	-11	14	-28 to 10	4
Minnesota—7 subjects:									
A	263	64	96	18	162	52	70	-71 to 147	4
B	292	110	15	211	30	-29	34	-98 to 2	6
CD	320	123	12	169	24	-28	23	-2 to 68	0
EF	238	112	14	148	34	-22	36	-101 to -2	6
GH	233	118	15	157	12	-43	22	-77 to -15	7
Nebraska—8 subjects:									
A	275	54	91	20	135	30	48	85	2
B	260	95	17	151	44	14	49	-54 to 71	3
CD	274	101	16	163	29	9	21	-16 to 42	3
EF	275	105	15	154	30	16	23	-12 to 52	3
GH	286	102	15	181	43	40	40	-87 to 26	2
Oklahoma—9 subjects:									
A	317	76	76	12	188	36	53	-75 to 134	2
B	251	87	13	141	40	23	34	-21 to 66	3
CD	247	2	8.5	12	166	18	14	-24 to 16	6
EF ¹	183	6	88	12	128	31	25	-80 to -3	8
GH ²	280	3	100	14	174	15	10	-6 to 22	3
All States:									
A—30 subjects	279	65	88	18	156	42	34	-75 to 147	10
B—30 subjects	263	17	96	19	160	45	40	-98 to 71	14
CD—30 subjects	272	29	102	20	164	24	5	-28 to 68	13

¹ Includes subjects 401, 403, 405, 407, and 409 for Periods EF and subjects 402, 404, and 406 for Periods GH.

² Includes subjects 401, 403, 405, 407, and 409 for Periods GH and subjects 402, 404, and 406 for Periods EF.

TABLE 17.—MAGNESIUM: *Regression of intake on excretion and balance*

Regression	Number of observations	b ¹	Proportion of variation explained by magnesium intake ²
Controlled magnesium intake, mg./day on—			
Urinary excretion, mg./day	53	³ 0.22	22
Fecal excretion, mg./day	53	³ .32	20
Retention, mg./day	53	³ .46	44
Self-chosen magnesium intake, mg./day on—			
Urinary excretion, mg./day	30	.04	2
Fecal excretion, mg./day	30	.21	11
Retention, mg./day	30	³ .75	57

¹ Change in excretion or retention for an increase of 1 mg. per day intake of magnesium.

² Square of correlation coefficient.

³ Significant at 1-percent level.

diets. The values for Period G in Minnesota and Periods E through H in Nebraska were omitted from the statistical treatment and from figure 4, in order to keep the length of time on each intake the same for all subjects.

No significant difference was found in the magnesium retention of the subjects in the four locations when analysis of covariance was employed to adjust for differences in intake. Variation in retention among subjects was not reduced when intake and retention were calculated on the basis of per kilogram of body weight.

Results of regression analyses are shown in table 17. The equation and the line for regression

of intake on balance are given in figure 4 for the controlled intakes and for the calculated self-chosen intakes. Magnesium excretion and balance increased significantly as intake increased. Because only 20 to 22 percent of the variation in excretion is explained by differences in the controlled intake, intake cannot be considered a good predictor of excretion. It can be used to help predict retention, however, inasmuch as 44 percent of the variation in retention values during periods of controlled intake is explained by differences in intake.

The regression values for Period A must be interpreted cautiously, because the magnesium intake was calculated from records of food intake estimated in terms of household measures rather than by quantitative analysis of actual intake. There was, however, a highly significant relationship between intake and retention, and 57 percent of the variation in retention was explained by differences in intake. The calculated magnesium content of the self-chosen diets ranged from 174 to 400 mg. daily. Ten subjects had intakes below 250 mg. and 9 of them were in negative balance. Of the 20 subjects with daily intakes above 250 mg., only one was in negative balance.

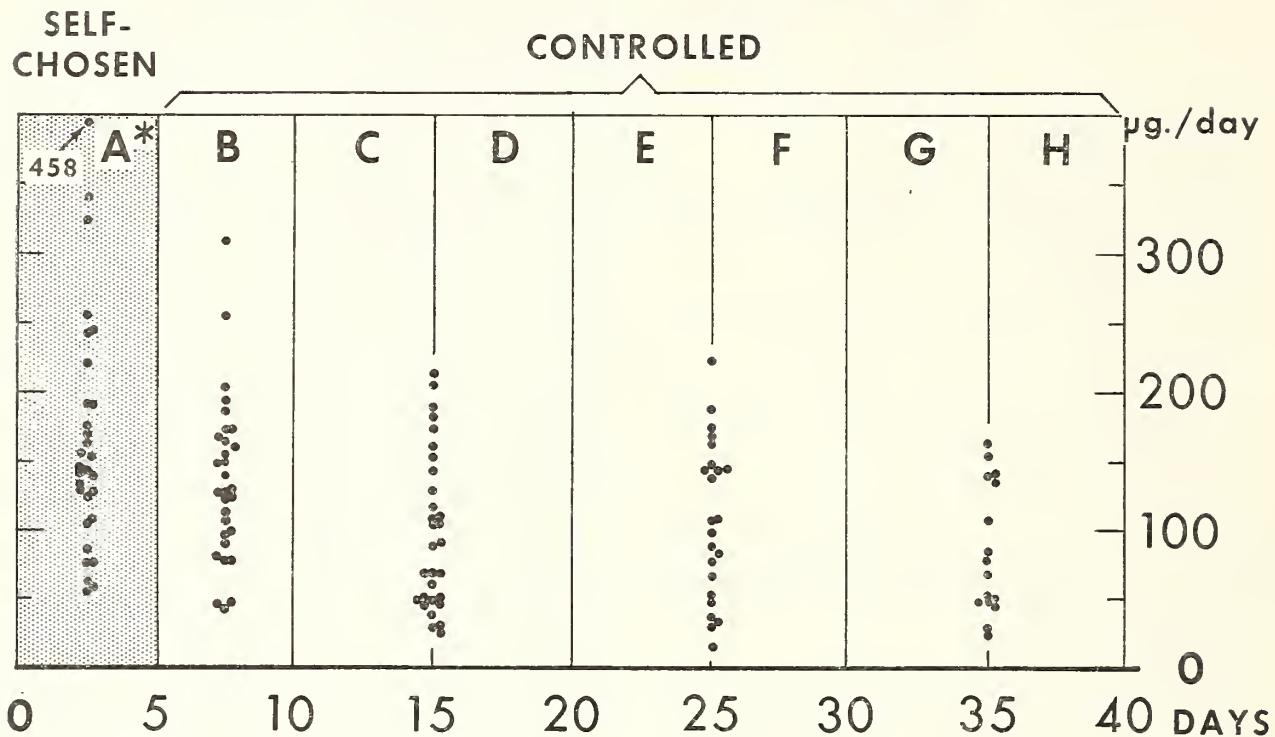
In table 18 the data have been grouped on the basis of the controlled levels of magnesium intake on which the subjects were studied. Both urinary and fecal excretion as well as retention increased directly with intake. Coefficients of variation for intake and excretion were stable for each group of magnesium intakes. Coefficients of variation for retention were about 80 percent for the low daily intake of 173 to 191 mg., and the high daily intake of 320 mg. of magnesium, and were about 200 percent for the two intermediate intake groups. Thus, there is little doubt about daily intakes from 173 to 191 mg. being inadequate, or

TABLE 18.—MAGNESIUM: *Mean, standard deviation, and coefficient of variation for daily intake, excretion, and balance for all subjects grouped according to intake*

Intake per day (milligrams) and subjects	Statistic	Intake	Urine	Feces	Balance
173-191—8 subjects-----	Mean-----	Milligrams 183	Milligrams 88	Milligrams 128	Milligrams -33
	Standard deviation-----	6	12	31	26
	Coefficient of variation (%)-----	(3)	(14)	(24)	(77)
233-252—22 subjects-----	Mean-----	245	99	158	-12
	Standard deviation-----	6	19	26	24
	Coefficient of variation (%)-----	(2)	(19)	(17)	(196)
274-282—16 subjects-----	Mean-----	277	101	170	7
	Standard deviation-----	3	15	23	16
	Coefficient of variation (%)-----	(1)	(15)	(14)	(223)
320—7 subjects-----	Mean-----	320	123	169	28
	Standard deviation-----	0	12	24	23
	Coefficient of variation (%)-----	0	10	14	83
173-320—53 subjects-----	Mean-----	255	101	158	-4
	Standard deviation-----	40	18	29	28
	Coefficient of variation (%)-----	(16)	(18)	(18)	(675)

URINARY EXCRETION OF THIAMINE

Variability on Controlled Diet for 35 Days



*SELF-CHOSEN DIET, THIAMINE CONTENT CALCULATED.

EACH LETTER REPRESENTS A 5-DAY PERIOD.

FIGURE 5.

about an intake of 320 mg. being adequate, for maintaining magnesium equilibrium in these subjects. Six, or 37 percent, of the 16 subjects who had daily intakes between 274 and 282 mg. of magnesium were excreting slightly more than they were taking in, but the extent of their negative balances was slight. Three of the six subjects had daily balances of -2 mg. and the other three had balances of -6, -16, and -20 mg. of magnesium daily.

The magnesium balances obtained during the periods of controlled intake suggest that a daily intake of at least 280 mg. of magnesium, and perhaps more, would be needed to insure equilibrium in a group of subjects similar to those in the present study. The data on magnesium have been presented in detail by Leverton and others (15).

Thiamine

The mean daily intake and urinary excretion of thiamine for the subjects in each State and for all of the subjects during different periods are given in table 19. The urinary excretion of each subject for the different periods is shown graphically in figure 5.

The calculated thiamine content of the self-selected diets of the 30 girls ranged from 640 to 1,760 μg. per day, with a mean of 1,203 μg. The urinary excretion of thiamine during this period ranged from 56 to 458 μg. daily, and the mean was 167 μg.

In the different States the standardized diet supplied from 741 to 832 μg. of thiamine per day in Periods CD. The intake was relatively constant at each location, beginning with Period B and continuing until the end of the study. These intakes were lower than those in Period A for 27 of the 30 subjects and resulted in a decrease in the urinary excretion of thiamine for 22 of these 27 women. The three subjects who had higher thiamine intakes on the standardized diet than in Period A also had higher urinary excretions in Period B.

The mean daily urinary excretion of the individual subjects ranged from 26 to 213 μg. of thiamine in Periods CD, from 19 to 214 μg. in Periods EF, and from 24 to 164 μg. in Periods GH. The values seemed to fall into two groups. During Periods CD the mean daily values for the 15 subjects studied in Alabama and Oklahoma

TABLE 19.—THIAMINE: *Mean and standard deviation for daily intake and urinary excretion for subjects in each State and for all subjects during different periods*

State, number of subjects, and period	Intake		Urine	
	Mean	Standard deviation	Mean	Standard deviation
Alabama—6 subjects:				
A-----	Micrograms 1,053	Micrograms 106	Micrograms 113	Micrograms 46
B-----	741	-----	81	30
CD-----	741	-----	60	18
Minnesota—7 subjects:				
A-----	992	251	162	56
B-----	832	-----	146	19
CD-----	832	-----	123	26
EF-----	852	-----	135	33
G-----	839	-----	120	30
Nebraska—8 subjects:				
A-----	1,200	328	235	116
B-----	774	-----	187	73
CD-----	790	-----	160	52
EF-----	719	-----	149	44
GH-----	750	-----	123	38
Oklahoma—9 subjects:				
A-----	1,470	199	146	83
B-----	775	1	123	44
CD-----	786	-----	53	26
EF—8 subjects-----	756	13	47	21
GH-----	761	5	49	18
All States:				
A—30 subjects-----	1,203	299	167	91
B—30 subjects-----	781	31	137	59
CD—30 subjects-----	789	31	101	56
EF—23 subjects-----	769	58	109	57
GH—16 subjects-----	755	6	86	47

ranged from 26 to 103 μg . and averaged 56 μg . as compared with a range of 62 to 213 μg . and a mean of 143 μg . for the other 15 subjects, those in Minnesota and Nebraska. The difference was statistically significant at the 1-percent level. In subsequent periods the urinary thiamine excretions of most of the subjects did not deviate greatly from what they had been in Periods CD. Six subjects in Nebraska had markedly lower values in Periods GH than in Periods CD; these subjects were the ones who had the highest excretions in Periods CD, from 142 to 213 μg . of thiamine.

Alteration in the intake of magnesium for Minnesota and Oklahoma subjects and of pantothenic acid for Nebraska subjects following Periods CD did not appear to affect thiamine excretion.

The 24-hour urinary excretion of thiamine has been used as a basis for evaluating nutritional

status of the body with respect to thiamine. The criteria suggested as indicative of adequate thiamine nutrition are (1) a 24-hour excretion of at least 100 μg . of thiamine (Mason and Williams, 17); (2) an excretion of at least 13 percent of the thiamine intake (Giff and Hauck, 10; Melnick, Field, and Robinson, 20); and (3) an excretion of at least 150 μg . of thiamine per gram of creatinine excreted (Adamson and others, 1).

In table 20 values are given for the mean daily urinary excretion of thiamine of the subjects for different periods expressed as per 24 hours, percentage intake, and per gram of creatinine excreted. Few subjects met all three of these criteria for adequate thiamine nutrition—9 in Period A, 4 in Periods CD, 2 in Periods EF, and none in Periods GH. In Period A when the calculated intakes ranged from 640 to 1,760 μg . of thiamine daily, only 6 subjects excreted less than 100 μg . of thiamine, but this number rose to 15 subjects in Periods CD when the intakes ranged from 741 to 832 μg . daily. Less than 13 percent of the thiamine intake was excreted by 14 of the subjects in Period A and 16 subjects in Periods CD. More subjects failed to meet the criteria of excreting at least 150 μg . of thiamine per gram of creatinine than failed to meet either of the other two criteria. In Periods A and CD, 20 and 25 subjects, respectively, excreted less than 150 μg . of thiamine per gram of creatinine.

The wide range in the urinary excretion of thiamine, sometimes exceeding tenfold, among the subjects on the standardized diet, together with the small proportion of subjects who met the criteria indicative of adequate thiamine nutrition, suggests that the daily intake of thiamine, approximately 800 μg ., was too low to be considered adequate for all subjects. The recommended daily allowance for thiamine is 1,200 μg . for young women 25 years of age with an energy requirement of 2,300 Calories. The thiamine intakes of the 9 subjects who met all 3 criteria for adequate thiamine nutrition during Period A on their self-chosen diets ranged from 1,100 to 1,760 μg . daily and averaged 1,357 μg .

Riboflavin

Mean values for the riboflavin intake and urinary excretion for the subjects in each State and for all subjects during different periods are given in table 21. The values for each subject during successive periods are shown in figure 6.

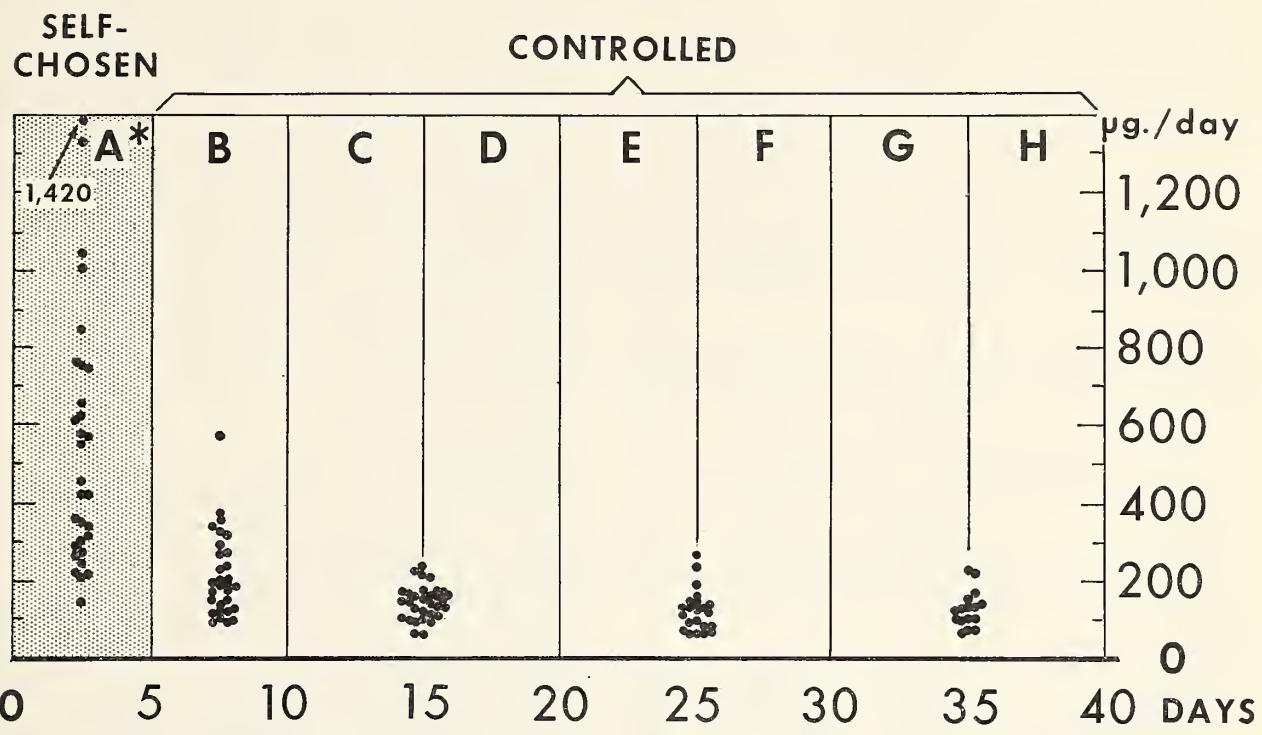
The calculated riboflavin content of the self-chosen diets in Period A ranged from 1,010 to 3,240 μg . daily, with a mean of 1,970 μg . for the 30 subjects. The daily urinary excretion for these subjects ranged from a low of 153 μg . (on an intake of 1,483 μg .) to a high of 1,420 μg . (on an intake of 2,120 μg .), and the mean excretion was 545 μg .

TABLE 20.—THIAMINE: Daily urinary excretion in terms of total, percentage of intake, and per gram creatinine for each subject in different periods

State and subject code number	Period A			Periods CD			Periods EF			Periods GH		
	Total	Portion of intake	Per gram creatinine	Total	Portion of intake	Per gram creatinine	Total	Portion of intake	Per gram creatinine	Total	Portion of intake	Per gram creatinine
Alabama:												
101	16.9	14.8	Micro-grams	61	8.2	Micro-grams	52	Micro-grams	52	Micro-grams	Percent	Micro-grams
102	5.6	5.4	grams	39	5.3	grams	42	grams	42	grams		grams
103	14.4	11.9	15.5	91	12.3	88						
104	10.5	11.0	76	50	6.7	39						
105	14.0	14.9	112	67	9.0	58						
106	6.2	6.0	49	52	7.0	45						
Mean	11.3	10.7	99	60	8.1	54						
Minnesota:												
201	25.5	18.8	92	90	10.8	68	92	10.8	70			
202	19.2	15.1	81	108	13.0	100	107	12.5	96			
203	12.5	12.2	116	12.5	96	108	12.7	12.7	99			
204	17.6	16.6	50	129	15.5	112	140	16.4	119			
205	7.6	10.3	64	116	13.9	92	149	17.5	112			
206	14.6	20.5	112	153	18.4	123	176	20.7	136			
207	16.4	20.2	146	162	19.5	149	170	20.0	152			
Mean	16.2	16.3	137	123	14.8	106	135	15.8	112			
Nebraska:												
301	2.42	18.0	216	183	23.2	176	154	21.4	143	140	18.7	133
302	3.12	26.1	255	213	27.0	205	214	29.8	186	154	20.5	137
303	1.43	18.3	101	110	13.9	85	100	13.9	72	84	11.2	59
304	1.91	13.2	60	142	18.0	134	144	20.0	126	107	14.3	91
305	1.08	7.3	84	62	7.8	52	79	11.0	64	54	7.2	45
306	4.58	30.7	347	206	26.1	163	190	26.4	145	142	18.9	110
307	2.45	22.1	163	174	22.0	135	145	20.2	108	136	18.1	99
308	1.53	23.9	116	190	24.1	165	163	22.7	137	164	21.9	139
Mean	2.35	19.6	180	160	20.3	139	149	20.7	123	123	16.3	102
Oklahoma:												
401	1.28	10.5	74	46	5.9	36	54	7.1	42	47	6.1	38
402	2.22	14.3	146	30	3.8	25	48	6.6	41	30	4.0	25
403	5.8	3.5	32	31	3.9	24	19	2.5	14	24	3.1	17
404	7.6	6.1	44	26	3.3	21	31	4.2	27	51	6.7	43
405	1.32	7.9	96	67	8.5	64	66	8.7	61	69	9.0	67
406	1.28	9.6	76	50	6.4	46	37	5.1	30	45	6.0	36
407	1.56	14.2	103	70	8.9	58	34	4.5	30	50	6.5	43
408	3.28	18.5	91	103	13.1	84	83	11.0	68	79	10.3	66
409	8.6	6.2	52									
Mean	1.46	9.9	90	53	6.7	45	47	6.2	39	49	6.5	42
All subjects	16.7	14.6	127	101	12.0	87	109	14.2	90	86	11.3	72

URINARY EXCRETION OF RIBOFLAVIN

Variability on Controlled Diet for 35 Days



* SELF-CHOSEN DIET, RIBOFLAVIN CONTENT CALCULATED.

EACH LETTER REPRESENTS A 5-DAY PERIOD.

FIGURE 6.

The shift from self-chosen diets to the standard diet meant a decreased riboflavin intake for every subject. The standard diet supplied from 872 to 970 μ g. of riboflavin daily in the different States (table 21). On this markedly lower intake the urinary excretion decreased also. For Periods CD the daily excretion ranged from 56 to 242 μ g.; for Periods EF from 61 to 267 μ g.; and for Periods GH from 66 to 222 μ g. (table 22).

Increases in the pantothenic acid intake which were made for the Nebraska subjects following Periods CD did not affect their riboflavin excretion. Similarly, increasing and decreasing the magnesium intake of Minnesota and Oklahoma subjects had no consistent effect on the excretion of riboflavin.

The nutritional status of the body with respect

to riboflavin is sometimes assessed on the basis of the 24-hour urinary excretion of the vitamin. The criteria which have been suggested as indicative of adequate riboflavin nutrition are the same as those mentioned for thiamine—total excretion, percentage of the intake excreted, and excretion per gram of creatinine. The ranges of normal values, however, are not as well established as for thiamine. Horwitt and others (13) have stated that a riboflavin excretion of less than 100 μ g. per 24 hours indicates previous dietary inadequacy. Morley and others (23) have judged the intake of their subjects to be adequate because the excretion represented 26 percent of the intake. Aykroyd and others (4) have suggested that an excretion of less than 200 μ g. per gram of creatinine is indicative of dietary inadequacy.

TABLE 21.—RIBOFLAVIN: *Mean and standard deviation for daily intake and urinary excretion for subjects in each State and for all subjects during different periods*

State, number of subjects, and period	Intake		Urine	
	Mean	Standard deviation	Mean	Standard deviation
Alabama—6 subjects:				
A-----	Micro-grams 1,987	Micro-grams 341	Micro-grams 546	Micro-grams 379
B-----	970	-----	208	86
CD-----	970	-----	152	28
Minnesota—7 subjects:				
A-----	1,866	582	453	258
B-----	953	-----	134	40
CD-----	949	-----	97	34
EF-----	969	2	98	32
G-----	976	-----	100	41
Nebraska—8 subjects:				
A-----	2,050	844	756	416
B-----	877	-----	350	73
CD-----	872	-----	189	36
EF-----	891	-----	172	53
GH-----	891	-----	155	42
Oklahoma—9 subjects:				
A-----	1,968	397	428	188
B-----	929	-----	175	66
CD-----	891	-----	138	31
EF—8 subjects-----	893	9	86	25
GH-----	892	3	100	36
All States:				
A—30 subjects-----	1,970	557	545	330
B—30 subjects-----	930	35	219	106
CD—30 subjects-----	915	40	145	45
EF—23 subjects-----	915	36	119	54
GH—16 subjects-----	892	2	128	47

The values for the urinary excretion of riboflavin of each subject expressed in the three ways are given in table 22. During the time they were receiving the standardized diet, which supplied approximately 900 μg . of riboflavin daily, the subjects did not consistently meet any of the criteria mentioned. More subjects, however, had a urinary excretion that equaled or exceeded 100 μg . of riboflavin daily than met the criteria of an excretion of 26 percent of the intake or an excretion

of 200 μg . of riboflavin per gram of creatinine. Of the 30 subjects, 5 excreted less than 100 μg . in Periods CD, with 10 of the 23 subjects in Periods EF and 4 of the 16 in Periods GH having excretions this low. As much as 26 percent of the riboflavin intake was excreted by only 1 subject in Periods CD and 2 subjects in Periods EF; and only 2 subjects in Periods CD and EF and 1 in GH excreted as much as 200 μg . of riboflavin per gram of creatinine. It appears that the 900 μg . of riboflavin daily in the standardized diet was not sufficient to maintain the subjects in adequate nutritional status with respect to riboflavin when judged by the usual criteria. This intake is only 60 percent of the 1,500 μg . which is the recommended allowance for riboflavin for young women.

The range among the subjects in their urinary excretion of riboflavin on the standardized diet was approximately fivefold as compared with tenfold for their excretion of thiamine.

Pantothenic Acid

Pantothenic acid intake and excretion were studied for the Nebraska subjects. The values for each subject are presented in table 23. The means and standard deviations for all subjects for each period are given in table 24.

By calculation from the records kept of the self-chosen diets of the subjects during Period A, from 3.4 to 10.3 mg. of pantothenic acid were supplied daily and the mean value was 6.7 mg. Calculation also indicated that 5 of the 8 subjects had diets which provided the nutrients in amounts that approached or exceeded the recommended allowances and these diets supplied approximately 7 mg. of pantothenic acid daily. The mean daily urinary excretion of all 8 subjects was 3.9 mg. of pantothenic acid, with a range of 2.9 to 7.5 mg.

The standardized diet supplied 2.8 mg. of pantothenic acid daily during Periods B, C, and D. During Periods EF, 5 mg. were added in the form of calcium pantothenate for subjects 301, 302, 303, and 304, and 10 mg. for subjects 305, 306, 307, and 308. In Periods GH the two groups of four subjects were switched. Subjects 301 to 304 received an additional 10 mg. of pantothenic acid, and subjects 305 to 308 received an additional 5 mg. of the vitamin. On intakes of 2.8, 7.8, and 12.8 mg. the daily excretion of pantothenic acid in the urine was 3.0, 4.5, and 5.6 mg., respectively. These amounts represented 107, 58, and 44 percent of the respective intakes.

TABLE 22.—RIBOFLAVIN: Daily urinary excretion in terms of total, percentage of intake, and per gram creatinine for each subject in different periods

TABLE 23.—PANTOTHENIC ACID: *Mean daily intake and urinary excretion for each subject for each period*

Subject code number and period	Intake	Urine	Subject code number and period	Intake	Urine
301:			305:		
A	7.3	3.5	A	7.2	3.2
B	2.8	2.7	B	2.8	3.2
C	2.8	3.3	C	2.8	2.8
D	2.8	3.2	D	2.8	2.4
CD	2.8	3.2	CD	2.8	2.6
E	7.8	4.3	E	12.8	5.2
F	7.8	4.6	F	12.8	5.4
EF	7.8	4.4	EF	12.8	5.3
G	12.8	6.1	G	7.8	4.7
H	12.8	6.0	H	7.8	3.6
GH	12.8	6.0	GH	7.8	4.2
302:			306:		
A	7.1	7.5	A	10.3	4.1
B	2.8	5.5	B	2.8	3.1
C	2.8	5.2	C	2.8	2.9
D	2.8	4.7	D	2.8	2.5
CD	2.8	5.0	CD	2.8	2.7
E	7.8	6.1	E	12.8	4.6
F	7.8	6.6	F	12.8	6.3
EF	7.8	6.4	EF	12.8	5.4
G	12.8	7.6	G	7.8	4.7
H	12.8	6.6	H	7.8	4.3
GH	12.8	7.1	GH	7.8	4.5
303:			307:		
A	4.3	3.3	A	6.9	3.6
B	2.8	3.2	B	2.8	3.3
C	2.8	3.0	C	2.8	2.8
D	2.8	2.8	D	2.8	2.7
CD	2.8	2.9	CD	2.8	2.8
E	7.8	3.4	E	12.8	4.8
F	7.8	3.4	F	12.8	5.3
EF	7.8	3.4	EF	12.8	5.0
G	12.8	5.0	G	7.8	5.5
H	12.8	6.2	H	7.8	5.0
GH	12.8	5.6	GH	7.8	5.2
304:			308:		
A	7.2	2.9	A	3.4	3.4
B	2.8	2.4	B	2.8	3.2
C	2.8	3.4	C	2.8	2.9
D	2.8	2.1	D	2.8	2.7
CD	2.8	2.8	CD	2.8	2.8
E	7.8	3.1	E	12.8	5.0
F	7.8	3.7	F	12.8	5.4
EF	7.8	3.4	EF	12.8	5.2
G	12.8	4.8	G	7.8	4.5
H	12.8	5.7	H	7.8	4.6
GH	12.8	5.2	GH	7.8	4.6

The differences between the mean pantothenic acid excretion on the three levels of intake are highly significant: Between intakes of 2.8 and 7.8 mg., $t=6.25$; between 7.8 and 12.8 mg., $t=4.01$;

and between 2.8 and 12.8 mg., $t=26.99$. The regression of pantothenic acid excretion on intake is shown in figure 7. The correlation coefficient is 0.805.

INTAKE AND URINARY EXCRETION OF PANTOTHENIC ACID

Controlled Diet

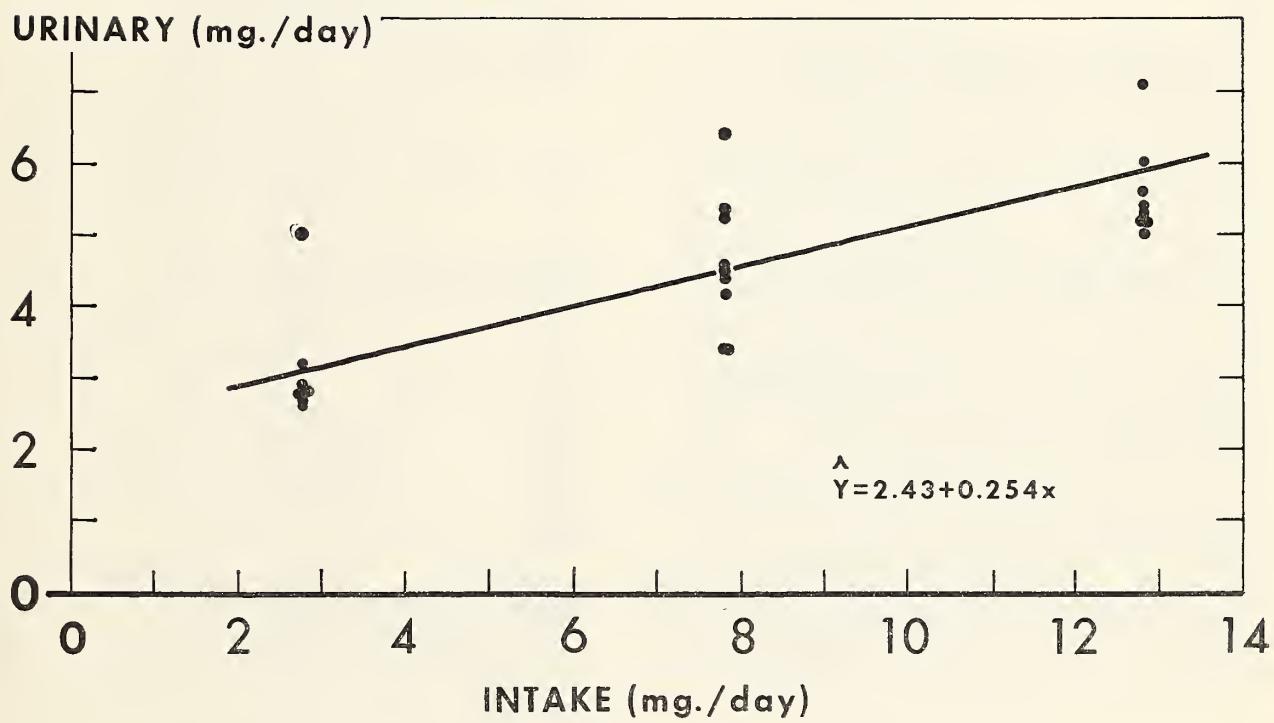


FIGURE 7.

TABLE 24.—PANTOTHENIC ACID: *Mean and standard deviation for all subjects for different periods*

Period	Subject code numbers	Intake	Urine	Standard deviation
		<i>Milligrams</i>	<i>Milligrams</i>	
A	301 to 308	6.7	3.9	1.5
B	301 to 308	2.8	3.3	.9
CD	301 to 308	2.8	3.1	.8
EF	301 to 304	7.8	4.4	1.4
EF	305 to 308	12.8	5.2	.2
GH	301 to 304	12.8	6.0	.8
GH	305 to 308	7.8	4.6	.4
EF	301 to 308	7.8	4.5	1.4
GH	301 to 308	12.8	5.6	.8
EF	301 to 308			

Fat

Data on the intake and fecal excretion of fat of the 30 subjects are summarized in table 25. The ranges in mean daily fat intake and excretion were wide during Period A on the self-chosen diets. The calculated intakes provided from 45.3 to 164.0 gm. of fat daily, with a mean of 107.2 gm. The daily fecal excretion for this period ranged from 1.64 to 8.84 gm. and averaged 4.8 gm.

The standardized diet provided about 90 gm. fat. This was less than 22 of the 30 subjects had been eating in their self-selected diets. Accompanying the lower intake of these 22 subjects in Periods CD, there was a reduced fecal excretion of fat by all but two of them. Subjects 302 and 304 excreted the same amounts on both intakes. Of the 8 subjects whose fat intake was increased when they were transferred to the standardized diet, 7 excreted less fat in the feces than on their self-chosen diets. Fecal fat values were relatively stable for all of the subjects throughout, from Periods CD until the end of the study. The range among individuals for Periods CD was from 1.38 gm. to 3.48 gm. fat. The greatest difference in fat excretion for any subject who was studied beyond

Periods CD occurred with subject 306 who excreted 1.79 gm. fat daily in Periods CD and 3.48 gm. in Periods GH. For most of the subjects, however, the differences were less than 0.5 mg.

TABLE 25.—FAT: *Mean and standard deviation for daily intake and fecal excretion for subjects in each State and for all subjects during different periods*

State, number of subjects, and period	Intake		Feces	
	Mean	Stand- ard devi- ation	Mean	Stand- ard devi- ation
			Grams	Grams
Alabama—6 subjects:				
A	108.3	12.3	5.3	0.7
B	86.4	—	2.4	.1
CD	86.4	—	2.4	.3
Minnesota—7 subjects:				
A	91.5	15.8	3.9	1.5
B	91.0	—	3.0	.8
CD	89.7	—	2.1	.6
EF	89.9	—	2.2	.4
G	86.2	—	2.5	.5
Nebraska—8 subjects:				
A	101.4	29.0	3.7	1.8
B	82.9	—	2.8	1.0
CD	92.3	—	2.2	.2
EF	90.9	—	2.1	.4
GH	91.7	—	2.4	.5
Oklahoma—9 subjects:				
A	124.0	24.8	6.2	1.5
B	88.2	—	3.2	1.4
CD	87.9	—	2.6	.4
EF—8 subjects	87.1	.3	2.7	.5
GH	87.7	1.1	2.5	.2
All States:				
A—30 subjects	107.2	24.7	4.8	1.8
B—30 subjects	87.0	3.0	2.9	1.0
CD—30 subjects	89.2	2.2	2.3	.5
EF—23 subjects	89.3	1.7	2.3	.5
GH—16 subjects	89.7	2.3	2.4	.4

LITERATURE CITED

- (1) ADAMSON, J. D., JOLLIFFE, N., KRUSE, H. D., and others. 1945. MEDICAL SURVEY OF NUTRITION IN NEWFOUNDLAND. *Canad. Med. Assoc. Jour.* 52: 227-250.
- (2) ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS. 1945. OFFICIAL AND TENTATIVE METHODS OF ANALYSIS OF THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS. Ed. 6, 932 pp., illus. Washington, D.C.
- (3) ASSOCIATION OF VITAMIN CHEMISTS, INC. 1947. METHODS OF VITAMIN ASSAY. 189 pp., illus. New York and London.
- (4) AYKROYD, W. R., JOLLIFFE, N., LOWRY, O. H., and others. 1948. MEDICAL RESURVEY OF NUTRITION IN NEWFOUNDLAND. *Canad. Med. Assoc. Jour.* 60: 3-30.
- (5) BOOTHBY, W. M., BERKSON, J., and DUNN, H. L. 1936. STUDIES OF THE ENERGY METABOLISM OF NORMAL INDIVIDUALS: A STANDARD FOR BASAL METABOLISM, WITH A MONOGRAM FOR CLINICAL APPLICATION. *Amer. Jour. Physiol.* 116: 468-484, illus.
- (6) BOWES, A. deP., and CHURCH, C. F. 1946. FOOD VALUES OF PORTIONS COMMONLY USED. Ed. 6. Campus Offset Press, Philadelphia, Pa.
- (7) CLARK, L. C., JR., and THOMPSON, H. L. 1949. DETERMINATION OF CREATININE AND CREATININE IN URINE. *Analyst. Chem.* 21: 1,218-1,221, illus.
- (8) DUBoIS, D., and DUBoIS, E. F. 1916. CLINICAL CALORIMETRY. X. A FORMULA TO ESTIMATE THE APPROXIMATE SURFACE AREA IF HEIGHT AND WEIGHT BE KNOWN. *Arch. Int. Med.* 17: 836-871, illus.
- (9) FISKE, C. H., and SUBBAROW, Y. 1925. THE COLORIMETRIC DETERMINATION OF PHOSPHORUS. *Jour. Biol. Chem.* 66: 375-400.
- (10) GIFFT, H. H., and HAUCK, H. M. 1946. A COMPARISON OF 4 METHODS FOR STUDYING THE URINARY EXCRETION OF THIAMINE. *Jour. Nutr.* 31: 635-646.
- (11) GODDARD, V. R., and GOODALL, L. 1959. FATTY ACIDS IN FOOD FATS. U.S. Dept. Agr. Home Econ. Res. Rpt. 7.
- (12) HATHAWAY, M. L. 1960. HEIGHTS AND WEIGHTS OF ADULTS IN THE UNITED STATES. U.S. Dept. Agr. Home Econ. Res. Rpt. 10, 110 pp.
- (13) HORWITZ, M. K., LIEBERT, E., KRIESLER, O., and others. 1948. INVESTIGATIONS OF HUMAN REQUIREMENTS FOR B-COMPLEX VITAMINS. *Natl. Res. Council Bul.* 116, 106 pp., illus.
- (14) INGOLS, R. S., and MURRAY, P. E. 1949. UREA HYDROLYSIS FOR PRECIPITATING CALCIUM OXALATE. *Analyst. Chem.* 21: 525-527, illus.
- (15) LEVERTON, R. M., LEICHSENRING, J. M., LINKSWILER, H., and MEYER, F. 1961. MAGNESIUM REQUIREMENT OF YOUNG WOMEN RECEIVING CONTROLLED INTAKES. *Jour. Nutr.* 74: 33-38.
- (16) MARKLEY, K. S., and HANN, R. M. 1925. A COMPARATIVE STUDY OF THE GUNNING-ARNOLD AND WINKLER BORIC ACID MODIFICATIONS OF THE KJELDAHL METHOD FOR THE DETERMINATION OF NITROGEN. *Assoc. Off. Agr. Chem. Jour.* 8: 455-467, illus.
- (17) MASON, H. L., and WILLIAMS, R. D. 1942. THE URINARY EXCRETION OF THIAMINE AS AN INDEX OF THE NUTRITIONAL LEVEL: ASSESSMENT OF THE VALUE OF A TEST DOSE. *Jour. Clin. Invest.* 21: 247-255.
- (18) MCCANCE, R. A., and WIDDOWSON, E. M. 1936. THE NUTRITIVE VALUE OF FRUITS, VEGETABLES, AND NUTS. [Gt. Brit.] *Med. Res. Council, Spec. Rpt. Ser.* 213: 34.
- (19) _____ and WIDDOWSON, E. M. 1947. THE CHEMICAL COMPOSITION OF FOODS. Ed. 2, 156 pp. Brooklyn.
- (20) MELNICK, D., FIELD, H., JR., and ROBINSON, W. D. 1939. A QUANTITATIVE CHEMICAL STUDY OF THE URINARY EXCRETION OF THIAMINE BY NORMAL INDIVIDUALS. *Jour. Nutr.* 18: 593-610.
- (21) MEYER, F. L., BROWN, M. L., WRIGHT, H. J., and HATHAWAY, M. L. 1955. A STANDARDIZED DIET FOR METABOLIC STUDIES; ITS DEVELOPMENT AND APPLICATION. U.S. Dept. Agr. Tech. Bul. 1,126, 81 pp., illus.
- (22) MICKELSEN, O., CONDIF, H., and KEYS, A. 1945. THE DETERMINATION OF THIAMINE IN URINE BY MEANS OF THE THIOCHROME TECHNIQUE. *Jour. Biol. Chem.* 160: 361-370, illus.
- (23) MORLEY, N. H., EDWARDS, M. A., IRGENS-MOLLER, I., and others. 1959. RIBOFLAVIN IN THE BLOOD AND URINE OF WOMEN ON CONTROLLED DIETS. *Jour. Nutr.* 69: 191-194.
- (24) NAJJAR, V. A. 1941. THE FLUOROMETRIC DETERMINATION OF RIBOFLAVIN IN URINE AND OTHER BIOLOGICAL FLUIDS. *Jour. Biol. Chem.* 141: 355-364.
- (25) NATIONAL ACADEMY OF SCIENCES-NATIONAL RESEARCH COUNCIL. 1958. RECOMMENDED DIETARY ALLOWANCES. A REPORT OF THE FOOD AND NUTRITION BOARD. *Natl. Acad. Sci.-Natl. Res. Council, Pub.* 589, 36 pp., illus.
- (26) _____ 1959. EVALUATION OF PROTEIN NUTRITION. A REPORT OF THE FOOD AND NUTRITION BOARD. *Natl. Acad. Sci.-Natl. Res. Council, Pub.* 711, 61 pp., illus.
- (27) ORANGE, M., and RHEIN, H. C. 1951. MICROESTIMATION OF MAGNESIUM IN BODY FLUIDS. *Jour. Biol. Chem.* 189: 379-386, illus.
- (28) ORR, M. L., and WATT, B. K. 1957. AMINO ACID CONTENT OF FOODS. U.S. Dept. Agr., Home Econ. Res. Rpt. 4, 82 pp.
- (29) SHERMAN, H. C. 1946. CHEMISTRY OF FOOD AND NUTRITION. Ed. 7, 675 pp. The Macmillan Co., New York.
- (30) SLATER, E. C., and MORELL, D. B. 1946. A MODIFICATION OF THE FLUORIMETRIC METHOD OF DETERMINING RIBOFLAVIN IN BIOLOGICAL MATERIALS. *Biochem. Jour.* 40: 644-652, illus.
- (31) WATT, B. K., and MERRILL, A. L. 1950. COMPOSITION OF FOODS . . . RAW, PROCESSED, PREPARED. U.S. Dept. Agr. Handb. 8, 147 pp.
- (32) ZOOK, E. G., MACARTHUR, M. J., and TOEPFER, E. W. 1956. PANTOTHENIC ACID IN FOODS. U.S. Dept. Agr. Handb. 97, 23 pp.

APPENDIX TABLE 26.—Data for individual subjects

State, subject code number, and period	Energy value	Nitrogen			Creatinine	Grams	Grams	Grams	Thiamine		Riboflavin	
		Intake	Urine	Feces		Intake	Feces	Intake	Intake	Urine	Intake	Urine
ALABAMA:												
101:												
A—	Cal. 2,572	Grams 14.6	Grams 9.38	Grams 1.22	Grams 4.00	Grams 1.19	Grams 119.7	Grams 4.54	μg_{169}	2,500	$\mu\text{g}_{1,016}$	
B—	2,178	10.65	8.61	.95	1.09	1.14	86.4	2.47	741	970	1,270	
C—												
D—												
CD—												
102:												
A—	2,110	12.0	7.10	1.34	3.56	.92	93.6	.02	1,040	56	1,510	221
B—	2,178	10.60	7.44	1.19	1.97	.88	86.4	2.48	741	44	970	140
C—												
D—												
CD—												
103:												
A—	2,370	13.5	6.55	1.27	5.68	.93	125.8	.18	1,210	144	1,780	365
B—	2,178	10.67	8.18	1.06	1.43	1.13	86.4	2.42	741	124	970	192
C—												
D—												
CD—												
104:												
A—	2,266	12.1	10.22	1.13	.75	1.39	103.8	6.61	950	105	2,200	1,045
B—	2,081	10.71	11.21	.87	1.37	1.36	86.4	2.41	741	49	970	344
C—												
D—												
CD—												
105:												
A—	2,066	12.4	8.78	1.12	2.50	1.25	99.0	5.35	940	140	1,950	361
B—	2,081	10.69	8.58	.84	1.28	1.17	86.4	2.53	741	96	970	196
C—												
D—												
CD—												
106:												
A—	2,233	12.6	9.01	1.38	2.21	1.26	107.9	5.05	1,040	62	1,980	269
B—	2,178	10.59	9.03	.63	.93	1.17	86.4	2.38	741	79	970	109
C—												
D—												
CD—												

MINNESOTA:

201:	A	14.80	11.05	1.22	.53	120.8	3.92	1,354	2,880
	B	10.91	9.42	1.21	.28	91.04	2.69	832	953
	C	11.95	9.06	.97	1.92	1.30	90.34	2.11	829
	D	12.36	9.36	.30	2.70	1.36	89.03	.65	93
	CD	12.16	9.21	.64	2.31	1.33	89.68	1.38	834
	E	11.14	9.22	.97	.95	1.30	89.94	2.56	849
	F	11.06	9.59	1.14	.33	1.34	89.89	2.56	856
	EF	11.10	9.40	1.06	.64	1.32	89.92	2.56	852
	G	11.11	9.68	.91	.52	1.32	86.22	2.11	839
	EFG	11.10	9.50	1.00	.60	1.32	88.68	2.41	848
202:	A	12.00	8.58	1.23	2.19	1.08	99.6	4.76	1,247
	B	10.97	8.75	1.12	1.10	1.06	91.04	2.78	832
	C	12.00	9.08	.89	2.03	1.07	90.34	2.44	829
	D	12.44	9.12	1.12	2.20	1.09	89.03	3.15	834
	CD	12.22	9.10	1.00	2.12	1.08	89.68	2.80	831
	E	11.18	8.37	1.13	1.68	1.14	89.94	2.86	849
	F	11.12	9.54	.98	.60	1.08	89.89	2.55	856
	EF	11.15	8.95	1.06	1.14	1.11	89.92	2.70	852
	G	11.17	9.51	1.21	.45	1.13	86.22	3.11	839
	EFG	11.16	9.14	1.11	.91	1.12	88.68	2.84	848
203:	A	11.62	7.32	1.22	3.08	1.08	83.2	4.54	1,024
	B	10.81	9.04	1.11	.66	1.02	91.04	3.34	832
	C	11.81	9.08	.82	1.91	1.03	90.34	1.61	829
	D	12.24	9.57	.54	2.13	1.13	89.03	1.60	834
	CD	12.02	9.32	.68	2.02	1.08	89.68	1.60	831
	E	10.99	9.22	.78	.99	1.10	89.94	2.43	849
	F	10.90	9.17	.35	1.38	1.09	89.89	1.17	856
	EF	10.94	9.20	.56	1.18	1.09	89.92	1.80	852
	G	10.95	9.37	.61	.97	1.14	86.22	2.22	839
	EFG	10.94	9.25	.58	1.11	1.11	88.68	1.94	848
204:	A	12.42	9.04	.84	2.54	1.17	97.3	3.91	1,060
	B	10.93	9.39	1.26	.28	1.12	91.04	2.67	832
	C	11.86	9.43	.91	1.52	1.16	90.34	2.04	829
	D	12.30	8.73	1.16	2.41	1.14	89.03	2.46	834
	CD	12.08	9.08	1.04	1.96	1.15	89.68	2.25	831
	E	11.05	9.70	.83	.52	1.18	89.94	1.76	849
	F	11.29	10.06	1.08	.15	1.17	89.89	2.56	855
	EF	11.17	9.87	.96	.34	1.17	89.92	2.16	852
	G	11.01	8.64	.96	1.41	1.22	86.22	2.21	839
	EFG	11.12	9.47	.96	.69	1.19	88.68	2.18	848

APPENDIX TABLE 26.—Data for individual subjects—Continued

State, subject code number, and period	Energy value	Nitrogen				Fat				Thiamine				Riboflavin	
		Intake	Urine	Fees	Balance	Creatinine	Grams	Grams	Grams	Urine	Intake	Urine	Intake	Urine	
MINNESOTA—Continued 205:															
A	Cal.	8.98	6.34	0.60	2.04	1.19	72.9	2.31	73.7	1,492	1,48	76	1,492	348	
B	2,163	10.72	8.84	.93	.95	1.24	91.04	1.90	83.2	953	148	76	953	94	
C	2,187	11.75	8.98	.87	1.90	1.25	90.34	1.52	82.9	125	106	926	106	55	
D	2,218	12.20	8.81	.76	2.63	1.27	89.03	1.82	83.4	106	972	972	972	67	
CD	2,202	11.98	8.90	.82	2.26	1.26	89.68	1.67	83.1	115	949	949	949	61	
E	2,244	10.95	9.23	.75	.97	1.33	89.94	1.60	84.9	151	849	849	849	73	
F	2,243	10.87	8.86	.94	1.07	1.34	89.89	2.11	85.6	147	856	856	856	80	
EF	2,243	10.91	9.05	1.02	1.02	1.33	89.92	1.86	85.2	149	968	968	968	76	
G	2,205	10.92	9.22	1.01	.69	1.36	86.22	2.07	83.9	128	976	976	976	50	
EF ²	2,230	10.91	9.10	.90	.91	1.34	88.68	1.93	84.8	142	971	971	971	68	
206:															
A	1,890	9.18	7.77	.76	.65	1.30	84.5	5.92	71.3	146	1,483	1,483	1,483	153	
B	2,160	10.73	8.94	.86	.93	1.26	91.04	2.68	83.2	154	953	953	953	90	
C	2,182	11.76	9.93	.63	1.20	1.26	90.34	2.78	82.9	152	926	926	926	77	
D	2,199	12.21	9.37	.57	2.27	1.22	89.03	3.02	83.4	154	972	972	972	94	
CD	2,190	11.98	9.65	.60	1.74	1.24	89.68	2.90	83.1	153	949	949	949	85	
E	2,204	10.96	9.62	.67	.67	1.28	89.94	2.31	84.9	170	985	985	985	56	
F	2,220	10.88	9.73	.57	.58	1.30	89.89	2.49	85.6	181	952	952	952	66	
EF	2,212	10.92	9.68	.62	.62	1.29	89.92	2.40	85.2	175	968	968	968	61	
G	2,234	10.93	9.26	.70	.97	1.27	86.22	3.45	83.9	155	976	976	976	66	
EF ²	2,219	10.92	9.53	.65	.74	1.28	88.68	2.75	84.8	169	971	971	971	63	
207:															
A	1,980	10.70	8.41	.42	1.87	1.12	82.2	1.64	81.2	164	1,879	1,879	1,879	419	
B	2,243	10.95	9.40	1.13	.42	1.12	91.04	4.59	83.2	157	953	953	953	198	
C	2,178	11.91	8.81	.82	2.28	1.08	90.34	2.09	82.9	148	926	926	926	131	
D	2,148	12.38	8.73	.74	2.91	1.09	89.03	1.66	83.4	175	972	972	972	154	
CD	2,163	12.14	8.77	.78	2.60	1.08	89.68	1.88	83.1	161	949	949	949	142	
E	2,185	11.14	8.75	.70	1.69	1.10	89.94	1.94	84.9	168	985	985	985	132	
F	2,165	11.05	9.74	.44	.87	1.20	89.89	1.30	85.6	173	952	952	952	117	
EF	2,175	11.10	9.25	.57	1.28	1.15	89.92	1.62	85.2	170	968	968	968	124	
G	2,164	11.10	9.38	.83	.89	1.18	86.22	2.39	83.9	164	976	976	976	124	
EF ²	2,171	11.10	9.29	.66	1.15	1.16	88.68	1.88	84.8	169	971	971	971	124	
NEBRASKA:															
301:	A	14.81	9.71	.83	4.27	1.12	122.3	3.25	1,340	242	2,280	2,280	2,280	758	
B	2,081	10.96	9.68	.57	.71	1.06	82.89	2.08	1,774	194	194	194	194	513	

APPENDIX TABLE 26.—Data for individual subjects—Continued

State, subject code number, and period	Energy value	Nitrogen			Creatinine	Fat		Thiamine		Riboflavin	
		Intake	Urine	Feces		Intake	Feces	Intake	Urine	Intake	Urine
NEBRASKA—Continued 305: A B	Cal. 2,648 2,081	Grams 13.87 10.95	Grams 9.23 9.38	Grams 1.31 .69	Grams 1.33 .88	Grams 1.29 1.27	Grams 128.1 82.89	μg. 1,480 774	μg. 108 78	μg. 2,020 877	μg. 617 275
C D CD	2,081 2,091 2,086	11.08 10.90 10.99	9.02 10.63 9.82	1.42 1.01 .72	1.64 -.74 .45	1.15 1.23 1.19	93.03 91.55 92.29	1.37 3.41 2.39	785 794 789	75 49 62	852 891 871
E F EF	2,131 2,161 2,146	10.98 10.92 10.95	9.90 8.80 9.35	.73 .72 .72	.35 1.40 .88	1.28 1.21 1.24	91.66 90.13 90.90	2.39 1.69 2.04	721 717 719	75 83 79	866 916 891
G H GH	2,241 2,281 2,261	11.00 11.03 11.02	9.07 8.66 8.86	.61 1.26 .94	1.32 1.11 1.22	1.19 1.19 1.19	91.91 91.58 91.74	1.57 3.51 2.56	757 742 749	54 53 53	896 886 891
306: A B	1,976 2,081	14.55 11.07	10.90 10.01	1.09 1.41	2.56 -.35	1.32 1.34	81.0 82.89	2.93 3.71	1,490 1,774	458 310	3,240 877
C D CD	2,081 2,081 2,081	11.18 11.02 11.10	9.29 9.16 9.22	.77 .55 .66	1.12 1.31 1.22	1.25 1.26 1.26	93.03 91.55 92.29	1.91 1.67 1.79	785 794 789	201 210 205	852 891 871
E F EF	2,081 2,081 2,081	11.12 11.03 11.08	9.79 9.93 9.86	.59 -.39 .49	.74 -.71 .72	1.30 1.32 1.32	91.66 90.13 90.90	1.99 1.37 1.68	721 717 719	176 189 189	866 916 891
G H GH	2,081 2,081 2,081	11.14 11.15 11.14	9.69 9.47 9.58	.61 1.23 .92	.84 1.28 .64	1.28 1.28 1.28	91.91 91.58 91.74	2.29 4.62 3.46	757 742 749	144 139 141	896 886 891
307: A B	2,098 2,081	13.57 11.07	12.22 11.02	1.35 1.46	-.00 -1.41	1.50 1.40	118.1 82.89	7.88 4.43	1,100 1,774	245 203	2,090 877
C D CD	2,081 2,081 2,081	11.19 11.02 11.10	9.80 9.50 9.65	.87 1.07 .97	.52 -.45 .48	1.30 1.28 1.29	93.03 91.55 92.29	2.01 2.59 2.30	785 794 789	175 173 174	852 891 871
E F EF	2,091 2,131 2,111	11.10 11.05 11.08	9.45 9.20 9.18	1.27 1.32 1.30	.68 .53 .60	1.33 1.34 1.34	91.66 90.13 90.90	2.56 2.69 2.62	721 717 719	129 161 145	866 916 891
G H GH	2,131 2,131 2,131	11.09 11.12 11.10	9.60 9.22 9.41	.95 .83 .80	.54 1.07 1.37	1.37 1.37 1.37	91.91 91.58 91.74	2.59 1.71 2.15	757 742 750	129 144 140	896 886 891

A	1,241	6.12	8.65	0.99	-3.52	45.3	3.09	153	1,010	240
B	2,081	10.95	9.67	.59	.69	1.25	82.89	774	877	371
C	2,081	11.08	9.38	1.12	.58	1.15	93.03	785	193	852
D	2,081	10.90	9.43	.79	.68	1.15	91.55	794	187	891
CD	2,081	10.99	9.40	.96	.63	1.15	92.29	789	190	871
E	2,081	10.98	9.74	.62	.62	1.21	91.66	721	157	866
F	2,081	10.93	10.00	1.14	-.21	1.16	90.13	2.99	169	916
EF	2,081	10.96	9.87	.88	.20	1.19	90.90	2.30	719	163
G	2,081	10.99	9.26	.90	.83	1.15	91.91	2.15	757	162
H	2,081	11.02	9.46	1.00	.56	1.20	91.58	2.18	742	165
GH	2,081	11.00	9.36	.95	.70	1.18	91.74	2.16	749	163
OKLAHOMA:										
401:										
A	1,922	10.9	8.48	1.32	1.10	1.73	85.00	5.14	1,220	1,430
B	2,213	11.01	6.90	.91	3.20	1.58	88.18	4.44	775	929
C	2,543	11.03	7.74	1.14	2.15	1.27	87.32	3.00	778	36
D	2,311	11.28	8.72	1.04	1.52	1.28	88.57	2.97	793	900
CD	2,427	11.16	8.23	1.09	1.84	1.28	87.94	2.98	785	882
E	2,394	10.34	8.34	1.02	.98	1.31	85.98	2.26	753	66
F	2,311	10.24	8.38	.92	.94	1.24	87.72	1.85	760	42
EF	2,352	10.29	8.36	.97	.96	1.27	86.85	2.06	756	54
G	2,416	10.76	8.70	1.18	.88	1.25	88.74	1.86	779	52
H	2,774	10.30	8.00	1.30	1.00	1.22	88.40	2.95	749	42
GH	2,595	10.53	8.35	1.24	.94	1.23	88.57	2.40	764	47
402:										
A	2,451	13.4	8.56	2.01	2.83	1.52	108.00	8.84	1,550	222
B	2,190	11.02	6.78	.64	3.60	1.47	88.18	2.08	775	128
C	2,561	11.04	7.48	1.11	2.45	1.21	87.32	3.99	778	24
D	2,307	11.28	8.44	1.05	1.79	1.16	88.57	2.97	793	36
CD	2,434	11.16	7.96	1.08	2.12	1.18	87.94	3.48	785	30
E	2,455	10.37	8.56	1.13	.68	1.18	86.18	3.19	720	52
F	2,434	10.85	9.48	1.23	.14	1.13	88.75	3.43	742	44
EF	2,444	10.61	9.02	1.18	.41	1.15	87.46	3.31	731	48
G	2,544	10.46	7.94	1.06	1.46	1.20	86.31	2.76	761	28
H	2,657	10.48	8.24	.93	1.31	1.20	86.09	2.40	749	32
GH	2,600	10.47	8.09	1.00	1.38	1.20	86.20	2.58	755	30

APPENDIX TABLE 26.—Data for individual subjects—Continued

State, subject code number, and period	Energy value	Nitrogen			Fat		Thiamine		Riboflavin	
		Intake	Urine	Feces	Intake	Feces	Intake	Urine	Intake	Urine
OKLAHOMA—Continued										
403:										
A	Cal 3,457	Grams 18.9	Grams 9.00	Grams 1.76	Grams 8.14	Grams 1.79	Grams 164.00	Grams 6.43	μg. 58	μg. 240
B	2,159	11.01	7.41	.94	2.66	1.74	88.18	3.44	168	929
C	2,489	11.04	7.42	1.20	2.42	1.30	87.32	2.26	778	34
D	2,210	11.28	8.78	.68	1.82	1.32	88.57	1.80	793	28
CD	2,349	11.16	8.10	.94	2.12	1.31	87.94	2.03	785	31
E	2,292	10.35	8.30	1.14	.91	1.33	85.98	2.87	753	16
F	2,281	10.25	7.94	1.01	1.30	1.31	87.72	1.45	760	22
EF	2,286	10.30	8.12	1.08	1.10	1.32	86.85	2.16	756	19
G	2,383	10.77	8.54	.91	1.32	1.47	88.74	2.23	779	22
H	2,622	10.31	9.05	1.05	.21	1.33	88.40	2.31	749	26
GH	2,502	10.54	8.80	.98	.76	1.40	88.57	2.27	764	24
404:										
A	2,234	11.7	9.30	1.26	1.14	1.71	97.00	6.43	1,240	76
B	2,112	11.01	6.88	.43	3.70	1.49	88.18	2.52	775	174
C	2,350	11.03	7.72	.32	2.99	1.24	87.32	1.25	778	24
D	2,152	11.28	8.06	1.17	2.05	1.20	88.57	3.74	793	28
CD	2,251	11.16	7.89	.74	2.52	1.22	87.94	2.50	785	26
E	2,276	10.37	8.90	.99	.48	1.19	86.18	3.39	720	30
F	2,225	10.84	8.74	.55	1.55	1.13	88.75	1.84	742	32
EF	2,250	10.61	8.82	.77	1.02	1.16	87.46	2.62	731	31
G	2,343	10.45	9.02	1.05	.38	1.19	86.31	3.38	761	68
H	2,408	10.47	7.82	.76	1.89	1.15	86.09	2.22	749	34
GH	2,375	10.46	8.42	.90	1.14	1.17	86.20	2.80	755	51
405:										
A	2,800	15.5	9.80	1.06	4.64	1.38	130.00	3.53	1,670	132
B	2,120	11.01	6.70	1.25	3.06	1.21	88.18	5.37	775	174
C	2,175	11.03	7.18	1.00	2.85	1.05	87.32	3.57	778	70
D	2,011	11.27	7.94	1.23	2.10	1.05	88.57	2.25	793	64
CD	2,093	11.15	7.56	1.12	2.48	1.05	87.94	2.91	785	67
E	2,033	10.34	8.74	1.09	.51	1.08	85.98	2.99	753	70
F	2,016	10.24	8.88	1.09	.27	1.08	87.72	2.56	760	62
EF	2,024	10.29	8.81	1.09	.39	1.08	86.85	2.78	756	66
G	2,011	10.76	8.54	.95	1.27	1.04	88.74	2.43	779	76
H	2,032	10.30	8.30	1.25	1.75	1.01	88.40	2.17	749	62
GH	2,021	10.53	8.42	1.10	1.02	1.02	88.57	2.30	761	69

406:

A	2, 335	12.5	9.12	1.69	1.69	116.00	6.29	1, 340	128	1, 630
B	2, 110	11.01	7.18	.98	2.87	1.26	87.32	3.19	778	40
C	2, 289	11.03	8.50	.75	2.03	1.28	88.57	2.29	793	52
D	2, 094	11.28	7.84	.86	2.45	1.27	87.94	2.74	785	46
CD	2, 191	11.16	7.84							891
E	2, 258	10.37	8.00	.85	1.52	1.25	86.18	2.21	720	50
F	2, 218	10.85	8.38	1.06	1.41	1.25	88.75	2.82	742	24
EF	2, 238	10.61	8.19	.96	1.46	1.25	87.46	2.52	731	37
G	2, 319	10.45	8.26	.84	1.35	1.25	86.31	1.97	761	52
H	2, 496	10.49	7.82	1.04	1.63	1.23	86.09	2.24	749	38
GH	2, 407	10.47	8.04	.94	1.49	1.24	86.20	2.10	755	45
										896
										890
										104

407:

A	2, 630	15.5	10.36	1.27	3.87	1.51	142.00	6.17	1, 390	2, 210
B	2, 116	11.02	7.04	1.10	2.88	1.35	88.18	4.14	775	82
C	2, 324	11.03	6.74	.95	3.34	1.06	87.32	2.37	778	50
D	2, 125	11.28	8.18	1.22	1.88	1.13	88.57	2.10	793	50
CD	2, 224	11.16	7.46	1.08	2.61	1.10	87.94	2.24	785	50
E	2, 229	10.35	7.94	1.18	1.23	1.14	85.98	3.59	759	40
F	2, 186	10.25	7.86	1.07	1.32	1.09	87.72	3.17	760	40
EF	2, 207	10.30	7.90	1.12	1.28	1.11	86.85	3.38	759	34
G	2, 266	10.77	8.60	.99	1.18	1.18	88.74	2.84	779	56
H	2, 349	10.30	8.04	1.07	1.19	1.16	88.40	2.74	749	44
GH	2, 307	10.54	8.32	1.03	1.18	1.17	88.57	2.79	764	50
										890
										890
										104

408:

A	3, 007	17.3	11.02	1.14	5.14	1.71	143.00	5.57	1, 760	326
B	2, 120	11.01	7.80	.35	2.86	1.48	88.18	1.44	775	128
C	2, 353	11.03	7.88	.63	2.52	1.18	87.32	2.42	778	70
D	2, 117	11.27	8.26	.71	2.30	1.24	88.57	2.85	793	70
CD	2, 235	11.15	8.07	.67	2.41	1.21	87.94	2.64	785	70
										891
										104

409:

A	2, 710	14.1	9.72	1.16	3.22	1.64	131.00	7.25	1, 390	86
B	2, 155	11.01	7.62	1.12	2.27	1.42	88.18	4.17	779	98
C	2, 338	11.03	6.72	.69	3.62	1.19	87.32	1.54	788	100
D	2, 151	11.29	9.06	1.33	2.90	1.26	88.57	2.98	793	106
CD	2, 244	11.16	7.89	1.01	2.26	1.22	87.94	2.26	785	103
E	2, 246	10.35	7.92	1.06	1.37	1.22	85.98	2.62	753	98
F	2, 261	10.25	7.78	.94	1.53	1.22	87.72	2.14	760	68
EF	2, 253	10.30	7.85	1.00	1.45	1.22	86.85	2.38	756	83
G	2, 354	10.77	8.02	.91	1.84	1.20	88.74	1.87	779	86
H	2, 476	10.35	8.38	1.21	.76	1.20	88.40	2.95	749	72
GH	2, 415	10.56	8.20	1.06	1.64	1.20	88.57	2.41	764	79
										890
										104

APPENDIX TABLE 26.—*Data for individual subjects—Continued*

MINNESOTA:
201:

A-----	1, 338	186	90	1, 062	1, 062	90	1, 844	953	613	278	354	219
B-----	1, 722	153	-337	561	570	-140	292	119	123	292	202	-29
C-----	731	156	-125	491	535	-3	319	124	210	121	88	-15
D-----	753	162	274	543	199	311	322	121	210	149	149	113
CD-----	742	159	487	1, 038	517	154	320	122	149	149	149	49
E-----	744	162	-284	976	642	-233	239	120	238	-119	-119	-29
F-----	728	157	786	-215	643	-206	236	131	188	-83	-83	-15
EF-----	736	160	826	-250	976	591	-220	238	126	-101	-101	-49
G-----	718	178	630	-90	982	445	-90	233	131	-57	-57	-29
EFG-----	730	166	760	-196	978	612	-176	236	127	195	195	-86
202:												
A-----	969	31	897	41	1, 431	680	607	144	301	98	216	-13
B-----	722	50	704	-32	991	568	391	32	292	130	176	-14
C-----	731	54	582	95	1, 023	538	301	184	319	134	166	19
D-----	753	42	738	-27	1, 033	622	401	30	322	130	193	-1
CD-----	742	48	660	34	1, 038	580	351	107	320	132	179	9
E-----	744	53	716	-25	976	533	435	8	239	108	158	-27
F-----	728	45	654	29	976	604	389	-17	236	122	137	-23
EF-----	736	49	685	2	976	568	412	-4	238	115	148	-25
G-----	718	44	789	-115	982	634	468	-120	233	134	176	-77
EFG-----	730	47	720	-37	978	590	431	-43	236	121	157	-42
203:												
A-----	559	227	407	-75	1, 025	596	352	77	231	113	189	-71
B-----	722	149	545	28	991	557	460	-26	292	106	220	-34
C-----	731	201	399	131	1, 023	480	309	234	319	114	136	69
D-----	753	187	437	129	1, 053	495	362	196	322	122	133	67
CD-----	742	194	418	130	1, 038	488	336	215	320	118	134	68
E-----	744	160	688	-104	976	483	540	-47	239	103	194	-58
F-----	728	174	360	-194	976	546	272	158	236	114	79	43
EF-----	736	167	524	45	976	514	406	56	238	109	137	-8
G-----	718	189	582	-53	982	568	440	-26	233	114	146	-27
EFG-----	730	174	543	13	978	532	417	28	236	110	140	-14
204:												
A-----	1, 347	96	994	-257	1, 533	775	532	226	260	83	164	13
B-----	1, 722	78	745	-101	991	629	422	-60	292	92	229	-29
C-----	731	94	590	47	1, 023	616	295	112	319	117	195	7
D-----	753	87	778	-112	1, 053	529	453	71	322	111	215	-4
CD-----	742	90	684	-32	1, 038	572	374	92	320	114	204	2
E-----	744	103	574	67	976	566	340	70	239	88	148	3
F-----	90	717	-81	974	566	431	-23	237	98	179	-40	-18
EF-----	735	96	646	-7	982	565	386	24	238	93	162	-22
G-----	718	86	690	-58	982	548	400	34	233	93	162	-20
EFG-----	729	93	660	-24	977	560	390	27	236	93	163	-20

APPENDIX TABLE 26.—Data for individual subjects—Continued

State, subject code number, and period	Calcium				Phosphorus				Magnesium			
	Intake	Urine	Fees	Balance	Intake	Urine	Fees	Balance	Intake	Urine	Feces	Balance
MINNESOTA—Continued 205:												
A-----	<i>Mg.</i> 847	<i>Mg.</i> 140	<i>Mg.</i> 415	<i>Mg.</i> 292	<i>Mg.</i> 970	<i>Mg.</i> 521	<i>Mg.</i> 282	<i>Mg.</i> 167	<i>Mg.</i> 180	<i>Mg.</i> 68	<i>Mg.</i> 122	<i>Mg.</i> -10
B-----	722	183	655	-116	991	535	420	36	292	93	197	2
C-----	731	172	644	-85	1,023	494	407	122	319	108	197	14
D-----	753	179	606	-32	1,053	471	363	219	322	103	182	37
CD-----	742	176	625	-58	1,038	483	385	170	320	105	189	26
E-----	744	166	570	8	976	535	389	52	239	98	131	10
F-----	728	172	627	-71	976	557	459	-40	236	98	152	-14
EF-----	736	169	598	-32	976	546	424	6	238	98	142	-2
G-----	718	164	632	-78	982	568	402	12	233	107	141	-15
EFG-----	730	167	610	-47	978	553	417	8	236	101	141	-6
206:												
A-----	901	158	612	131	1,053	596	370	87	199	92	154	-47
B-----	722	146	628	-52	991	559	449	-17	292	106	187	-1
C-----	731	170	592	-31	1,023	579	351	33	319	127	170	22
D-----	753	158	622	-27	1,053	592	393	68	322	136	156	30
CD-----	742	164	607	-29	1,038	586	372	80	320	131	163	26
E-----	744	184	550	10	976	589	359	28	239	113	129	-3
F-----	728	173	578	-23	976	616	349	11	236	108	116	12
EF-----	736	178	564	-6	976	602	354	20	238	111	123	4
G-----	718	164	803	-249	982	554	462	-34	233	121	164	-52
EFG-----	730	174	644	-87	978	586	390	2	236	114	136	-14
207:												
A-----	1,155	112	438	605	1,301	665	248	388	316	95	74	147
B-----	722	99	1,285	-662	991	601	742	-352	292	124	266	-98
C-----	731	109	610	12	1,023	644	331	48	319	142	185	-8
D-----	753	88	559	106	1,053	596	320	137	322	137	146	39
CD-----	742	98	584	59	1,038	620	326	92	320	139	165	16
E-----	744	120	548	76	976	584	376	16	239	135	127	-23
F-----	728	89	400	239	976	645	228	103	236	127	91	18
EF-----	736	104	474	158	976	614	302	60	238	131	109	-2
G-----	718	87	775	-144	982	602	438	-58	233	128	153	-48
EFG-----	730	99	574	57	978	610	347	20	236	130	124	-18
NEBRASKA:												
301:												
A-----	1,350	296	923	131	1,669	845	529	255	319	109	156	54
B-----	718	233	658	-173	959	511	439	9	260	91	146	23

C	240	483	2	938	277	131
D	241	770	-279	946	271	213
CD	240	626	-138	942	274	104
E						
F	724	238	576	-90	957	109
G	728	216	326	186	537	105
H	726	227	451	48	278	107
GH	729	226	549	-46	398	155
C	743	208	442	93	492	73
D	716	245	656	-186	944	287
CD	729	226	549	945	488	105
E						
F						
EF						
G						
H						
GH						
302:						
A		1,108	176	762	170	1,421
B		718	128	979	-389	959
C	725	121	673	-69	938	603
D	732	136	505	91	946	424
CD	728	128	589	11	942	319
E						
F						
EF						
G						
H						
GH						
303:						
A		495	159	564	-228	1,050
B		718	135	467	116	959
C	725	152	536	37	938	550
D	732	182	805	-255	946	532
CD	728	167	670	-109	942	541
E						
F						
EF						
G						
H						
GH						
304:						
A		975	138	442	395	1,441
B		718	101	399	218	959
C	725	120	512	93	938	592
D	732	112	695	-75	946	609
CD	728	116	604	9	942	600
E						
F						
EF						
G						
H						
GH						

APPENDIX TABLE 26.—Data for individual subjects—Continued

State, subject code number, and period	Calcium				Phosphorus				Magnesium			
	Intake	Urine	Feces	Balance	Intake	Urine	Feces	Balance	Intake	Urine	Feces	Balance
NEBRASKA—C—Continued 305:												
A	1,187	213	737	550	237	878	394	278	302	118	115	69
B	718	189	419	959	110	740	203	16	260	120	85	55
C	725	198	304	946	223	938	607	175	277	123	70	84
D	732	207	750	942	—225	946	680	465	271	137	179	—45
CD	728	202	527	644	—1	942	644	320	274	130	124	20
E	725	218	476	649	31	958	649	305	4	283	125	36
F	729	209	381	953	139	953	603	226	124	267	120	28
EF	727	214	428	956	85	956	626	266	64	275	123	32
G	744	164	333	946	247	947	693	193	61	287	133	85
H	718	173	817	946	—272	946	584	477	—115	284	108	69
GH	731	168	575	638	—12	946	638	335	—27	286	121	—17
306:												
A	1,001	190	437	946	374	1,461	825	318	301	79	123	99
B	718	208	743	959	—233	959	503	532	—166	260	99	215
C	725	208	421	946	96	938	513	333	92	277	102	139
D	732	218	399	946	115	946	495	348	103	271	93	129
CD	728	213	410	942	106	942	504	340	98	274	98	134
E	724	200	453	71	957	589	358	10	283	101	149	33
F	728	184	316	952	228	952	580	244	128	267	100	96
EF	726	192	384	954	150	954	584	301	69	275	100	123
G	743	220	589	946	—66	946	505	511	—70	287	113	185
H	715	214	1,086	944	—585	944	484	932	—472	284	94	353
GH	729	217	838	945	—326	945	494	722	—271	286	104	269
307:												
A	1,080	218	755	1,445	107	1,445	892	485	68	305	107	162
B	718	151	743	959	—176	959	709	491	—241	260	117	183
C	725	163	462	100	938	685	294	—41	277	114	130	33
D	732	145	589	—2	946	649	371	—74	271	112	163	—4
CD	728	154	526	49	942	667	332	—58	274	113	147	14
E	724	163	549	12	957	670	312	—25	283	110	158	15
F	729	172	613	—56	953	632	360	—39	267	125	167	—25
EF	726	168	581	—22	955	651	336	—32	275	118	162	—5
G	744	154	695	—105	947	632	353	—38	287	125	174	—12
H	716	140	394	182	38	946	634	247	62	284	109	61
GH	730	147	544	38		946	634	300	12	286	117	145

A-----	612	207	546	499	623	763	70	173
B-----	718	216	428	561	599	741	73	116
C-----								
D-----								
CD-----								
E-----								
F-----								
EF-----								
G-----								
H-----								
GH-----								
OKLAHOMA:								
401: A-----								
B-----								
C-----								
D-----								
CD-----								
E-----								
F-----								
EF-----								
G-----								
H-----								
GH-----								
402: A-----								
B-----								
C-----								
D-----								
CD-----								
E-----								
F-----								
EF-----								
G-----								
H-----								
GH-----								

APPENDIX TABLE 26.—Data for individual subjects—Continued

State, subject code number, and period	Calcium						Phosphorus						Magnesium		
	Intake	Urine	Fees	Balance	Intake	Urine	Fees	Balance	Intake	Urine	Fees	Balance	Mg.	Mg.	Mg.
Oklahoma—Continued													236	236	81
403:													174	174	-10
A—	<i>Mg.</i> 1,130	<i>Mg.</i> 281	<i>Mg.</i> 1,013	<i>Mg.</i> 527	<i>Mg.</i> -164	<i>Mg.</i> -25	<i>Mg.</i> 1,540	<i>Mg.</i> 901	<i>Mg.</i> 754	<i>Mg.</i> 584	<i>Mg.</i> 425	<i>Mg.</i> 240	390	73	
B—	807	305											251	87	
C—	831	251	589	-9	941	584	278	79	244	80	210				-46
D—	834	220	364	250	933	550	182	201	252	80	131				41
CD—	832	236	476	120	937	567	230	140	248	80	170				-2
E—															
F—															
EF—															
G—															
H—															
GH—															
404:															
A—	770	168	1,093	-491	1,130	604	613	-87	350	66	221				63
B—	806	376	359	71	901	392	198	311	251	86	99				66
C—															
D—															
CD—															
E—															
F—															
EF—															
G—															
H—															
GH—															
405:															
A—	1,150	106	804	-240	1,570	640	395	535	336	62	140				134
B—	806	139	933	-266	901	386	515	0	251	77	195				-21
C—															
D—															
CD—															
E—															
F—															
EF—															
G—															
H—															
GH—															

406:

A	953	189	222	419	719	-148	939	478	279	182	242	94	159	191
B	806	1,000			256	709	-118	931	554	209	168	250	124	104
C	827			831	232	481	-15	935	516	244	175	246	94	142
D				829	244	600	-15							-11
CD														-31
E														10
F														-26
EF														-31
														-2
G														-7
H														-2
GH														-4
407:														
A														
B														
C														
D														
CD														
E														
F														
EF														
G														
H														
GH														
408:														
A														
B														
C														
D														
CD														
409:														
A														
B														
C														
D														
CD														
E														
F														
EF														
G														
H														
GH														

